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THE SENSORY DISTRIBUTION OF THE FIFTH CRANIAL NERVE.

By Harvey Cushing, M. D.,

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There are several ways in which the confines of the trigeminal sensory field may be more or less accurately determined.

First of all, morphological studies serve to indicate what the boundary is likely to be, inasmuch as the structures that develop cephalad to the first visceral cleft will, in the natural order of things, receive their sensory supply solely from the N. trigeminus.

In the second place, anatomical dissections furnish possibly the most simple and commonly utilized means of establishing the destination of the finer ramifications of this as of any other nerve whose main radicle enters into no plexiform relations with its neighbors.

A third method is the experimental one in which comparative observations in the lower animals are made upon the functional, rather than the anatomical field of distribution; either by section of the nerve in question and determination of the resultant field of "no response" to sensory stimuli, or else by section of the adjoining roots leaving intact the sensativity of the area to be demarcated. Thus a negative as well as a positive field may be surveyed and the physiological overlap from one side or the other be determined.

There remain, finally and fourthly, the opportunities which are offered by the study of clinical cases. The various conditions encountered at the bedside may be conveniently divided into two groups. One of these, the more objective, presents a visible peripheral lesion resultant upon pathological changes of one sort or another in the posterior root ganglia; the other partakes of the principles involved in the preceding paragraph, the opportunity being grasped of outlining the area of disturbed sensation when, from disease, accident or intent, the continuity of the nerve or of its neighbors has been severed.

In this paper, as was the case in the studies which led to it,

the subject will be approached primarily from the standpoint of this fourth method and the relationship to the clinical findings which are borne by observations made after one or another of the first three methods will be discussed secondarily.

I. Results of Clinical Observations.

Of those clinical states bearing an apparent relation to the partial loss of trigeminal control and all of which presumably indicate disturbances situate in the ganglion, congenital nævi, progressive hemifacial atrophy and herpes zoster alone need be mentioned as giving characteristic objective lesions that conform more or less closely in distribution with one or another division of the familiar trigeminal skin-field. Even zoster, however, far the most definite of these states, indicates territorial outlines very roughly at best and valuable as has been the evidence that studies of herpetic eruptions have given in regard to segmental topography, accurate delineation of segmental boundaries is not looked for from data furnished by these cases. The same may be said of some states of a purely subjective nature which similarly are useful and interesting rather as furnishing confirmation of the outlines determined in other ways, than as adding anything more to their definiteness. For example, intra-cranial disturbances may at times, by reflex action through the trigeminus, give pain with hyperæsthesia and tenderness over the entire field of sensory distribution of the nerve. I have twice seen patients suffering from the effects of a small extradural abscess of otitic origin in whom it was possible to clearly delineate the trigeminal outline including its auricular portion, by this hypersensitiveness to tactual impressions, though it may be doubted whether the accuracy of the outline would have been recognized without a thorough preliminary acquaintance with the normal boundary. The same statement applies to those cases of severe major neuralgia in which the entire sensory field of the fifth may be included in the paroxysmal wave of pain.

Instances of traumatism, or of progressive involvement of the nerve in morbid processes in such wise as to interrupt afferent impulses, have supplied, heretofore, the chief opportunities of determining in man the function and distribution of the trigeminus. It would be unusual for a single observer to have for a study a considerable series of such cases and the lesions, unfortunately, are rarely uncomplicated, sufficiently circumscribed, or if so, possible to authenticate by a post-mortem examination and intracranial lesions of any seriousness are too apt to leave patients in a condition in which it is difficult to properly carry out delicate sensory examinations. It is, possibly, for this reason, rather than because of the supposed great variability in outline of the trigeminal field, that one finds in standard text-books of medicine and neurology so great a lack of unanimity in the described and pictured boundaries of this area.

Needless to say, no clinical condition offers opportunities so favorable for subsequent study of the function of the fifth nerve as that supplied by a purposeful intracranial neurectomy. In no other way is it possible to obtain for study an uncomplicated group of cases presenting this simple lesion alone and from which may be gathered the average normal distribution as well as its variations. It is often said that the conditions are comparable to those of an accurate physiological experiment, but they are much more than that. The stumbling block of the laboratory in studies of sensory nerve distribution has been not only the great difficulty of eliciting responses but of interpreting the animal's sensations, a matter so subjective that verbal communication is necessary. This is possible only between man and man, and even here a mind more acute than the ordinary on the part of the subject is desirable since only by the observer's interpretation of the patient's own comment upon his sensations, for which any one has but a small vocabulary, can data of great reliability be obtained. Little has been added to our knowledge of the consequences of this operation from an anatomical and physiological point of view since the publication in 1896 of Krause's well-known monograph.[1] Six of the cases which at that time formed the basis of his studies were therein reported with especial care from the standpoint of the post-operative sensory disturbances and his findings will be commented upon later on. Most of the surgeons, other than Krause, who have had a series of these cases sufficient to furnish material for similar observations, have devoted their reports more to the operative aspect of ganglion extirpation than to the study of its physiological consequences.[2] The observations are, unfortunately, time-consuming and tedious, and only a spirit of investigation would provoke their study. They are, furthermore, as fatiguing to the patient as to the observer, and it is necessary to have the absolute co-operation of the former and the willingness of both to sacrifice time. Happily, those individuals who have been released from the indescribable sufferings of extreme forms of neuralgia quniti major are willing enough to lend themselves to the annoyance and tedium of sensory tests, and happily again, convalescence, as a rule, is so rapid from this operation that observations may be profitably begun on the succeeding day and be corroborated or added to by frequent examinations during the period of hospital residence.

The series of cases of ganglion extirpation or of division of the trigeminal sensory root from which have been obtained the results to be given in this paper are twenty-six in number. Of these, a few of the earlier cases are comparatively of little value, for although the extirpation in the majority of them was total, the anæsthetic areas, as the records and the photo-

[1] Fedor Krause: Die Neuralgie des Trigeminus nebst der Anatomie und Physiologie des Nerven. Leipzig. F. C. W. Vogel, 1896.

[2] Frequently diagrams or photographs accompany the reports of these operations, showing the resultant area of anæsthesia without comment upon the method of testing the same. From the configuration of the area which is usually delineated in those cases, in which a total extirpation has been assured, one would judge that it represented the outline of total analgesia as it would be conveniently mapped out by a pin or needle.

graphs show, were very casually mapped out, and usually to one form of sensation alone. Subsequent examinations in some of these cases, even after three or four years, have revealed outlines which indicate the crudeness of the earlier delineations. In all of the later cases great pains have been taken to carefully trace the boundary lines of anæsthesia to all forms of sensation, and, as will be seen, with the result of determining a definite outline from which in the great majority of cases there is only the very slightest individual deviation. Several of the cases, furthermore, had had no preliminary neurectomies of peripheral nerves so that possible functional overlapping on long-standing patches of anæsthesia was the source of no confusion during the early tests.

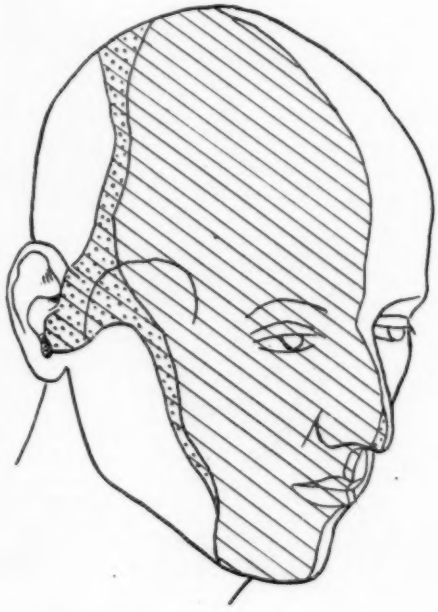

FIG. 1.—Diagram showing the normal (average) field of post-operative cutaneous anæsthesia. The shaded area including tragus and anterior wall of meatus remains anæsthetic to tactual (hair æsthesiometer) stimuli. The dotted strip gives the impression of touch or pressure to pain stimuli (needle) with few if any actual pain points.

For making the tests the following appliances have been used: for touch, a horse hair arranged like a v. Frey æsthesiometer, of a length just sufficient, owing to bending on impact, to give tactile instead of a dolorous sensation in case it impinged upon a pain point; for pain, a needle or sharp pin placed obliquely on the end of a light cardboard handle, thus allowing of more delicate stabs of the skin than when held in the fingers; for thermic tests, a camel's hair brush wet with ether for cold, and for heat the warmed head of a pin or else the convenient hot and cold test-tube. Electrical tests have also been used in the majority of the more recent cases. On the skin there is no more satisfactory way of delineating the outline of tactual anæsthesia. A unipolar electrode of fine platinum wire with the faradic current has generally been employed; this gives the electrical sting or "whirr" only on a field of tactual æsthesia. In making the tests the field margins were approached always from a known area of anæsthesia. The patient, so far as possible, was always alone with the observer in quiet surroundings and the observations were invariably deferred when evidence of even a slight degree of fatigue was given by uncertainty or delay in the responses.

Comment will be made:

1. Upon the field of cutaneous anæsthesia.
2. Upon the anæsthesia of the mucous membranes.
3. Upon disturbances of "muscular sense."
4. Upon the distribution to the meninges.
5. Upon the sensory distribution of adjoining fields.

FIG. 2.

6. Upon the overlap and permanence of anæsthesia.

1. *Outline of the Cutaneous Field.*—There are two lines which in every case may readily be mapped out as delineating phases of anæsthesia at the *posterior boundary* of the trigeminal skin field (Fig. 1); the more anterior of these lines bounds the area within which anæsthesia is complete to all forms of sensation; the more posterior, outlines the area within which the anæsthesia, though complete to thermic, dolorous and delicate tactual stimuli, nevertheless is not absolute since perception for painful stimuli remains, the impulses being interpreted, however, not as pain but as pressure or contact (common sensation). There exists, therefore, a strip of skin between these two lines from which sensory responses may be elicited, and although, properly speaking, the posterior of the lines encloses the functional area of trigeminal distribution for pain, touch and temperature, the anterior represents the line which would be mapped out by the experi-

mental method on animals as enclosing the field of 'no response' whatever. This will be commented upon later in discussing Sherrington's findings in the monkey.

In the twenty-six cases of trigeminal neurectomy from which these studies have been made the great preponderance of one type, occurring as it does in twenty instances with but little variation from case to case, indicates that this stands as the average normal cutaneous distribution. Instances of this normal type are shown in the accompanying photographs, taken from eight to ten days after the operation, of patients on whom the field had been mapped out (Figs. 2-7). A comparison with the photographs and diagrams of the anæsthesia after cervical nerve lesions (Figs. 14-19) renders it evident at

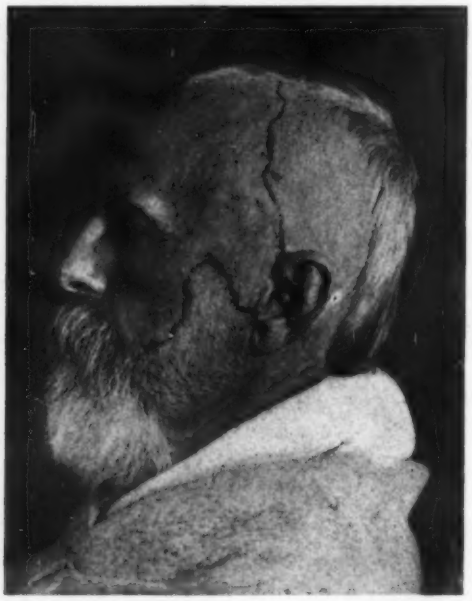

FIG. 3.

once that the border zones between the cranial (trigeminal) and the adjoining spinal field (second cervical) either offer an exception to the general laws of overlapping which Sherrington has shown to apply to the border areas between neighboring skin-fields of spinal origin, or else through the greater accuracy of the tests which are possible in the human subject, the exact anatomical delineation of a segmental skin-field may be determined, after the section of its dorsal root, regardless of the possible functional overlap with adjoining segments.

It has been determined on experimental grounds, as is well known, that the overlap between adjoining segments is sufficient to leave no area with deficient tactual sensativity after the section of a single dorsal root, the tactual overlap in fact being greater than that for pain and temperature, a dorso-ventral strip of at least partial analgesia and thermo-anæsthesia remaining after a single spinal root division.[3]

[3] Sherrington: The Spinal Roots and Dissociative Anæsthesia in the Monkey. Journal of Physiology, Vol. XXVII.

In the case of the trigeminal field in man, at all events, it seems quite otherwise since the only observable overlap on the trigeminal field, at least of its mandibular portion, after division of the sensory root is for pain alone, although, as already stated, painful impulses from the field of overlap, if it is to be regarded as such, when perceived are not dolorous.[4]

Particular attention has been paid in these cases of trigeminal neurectomy to the delineation of the *field of post-operative tactual anæsthesia* inasmuch as points of chief interest have been obtained therefrom and the outline thus plotted seemingly represents the extent of anatomical distribution of the terminals of the nerve. This boundary line may be traced as follows: Starting from the mid-longitudinal line of the

FIG. 4.

FIGS. 2–4.—Photographs of patients 8 to 10 days after the operation showing area of tactual anæsthesia alone.

scalp at a point which roughly corresponds with the upper end of the underlying Rolandic fissure, the line crosses the scalp

[4] This statement has been restricted to the field of the N. mandibularis division of the trigeminus since it is possible that the overlap which exists at the vertex between the second cervical field and the ophthalmic division of the trigeminus may be somewhat more marked. This deserves further study. It is not impossible that the first visceral cleft may have furnished a barrier to overlapping ventral to the ear that does not exist in the parts dorsal to it. This may explain the slighter overlap in the ear-cheek-chin portion that exists on the crown. It must be borne in mind, of course, that the Gasserion ganglion represents in all probability a fusion of three separate cranial dorsal root ganglia, the groups of cells corresponding to each division remaining more or less distinct, as the observations, which Dr. Barker and the writer made a few years ago would indicate, the degenerated cells after peripheral evulsion of one or another of the main trunks lying in a definite group and not being scattered throughout the ganglion as might be expected. Sherrington has shown however and clinical observations confirm the fact that the

with some irregularities but generally in a forward and downward direction much as does this underlying cerebral fissure; it then drops to the anterior attachment of the pinna around the edge of which it curves in a backward direction so as to include a small section of the ascending rim of the helix, together with the entire crus of the same; thence it disappears in the external auditory canal at the upper edge of the meatus; from this point the line passes into the canal along its upper wall as far as the tympanic membrane, which is included to a greater or less extent in the anæsthetic area, returns along the lower and anterior wall of the canal to the lower edge of the tragus, where it once more reappears on the exposed cutaneous surface; thence it passes at a greater or less angle in a forward and slightly upward direction across the zygomatic region for

FIG. 5.

a distance of from 3 to 5 cm. before turning and sweeping downward across the cheek, still keeping nearly 5 cm. from the posterior edge of the ascending maxillary ramus (about half-way between the angle of the jaw and corner of the mouth) until it drops under the edge of the horizontal ramus and regains the mid line 1 or 2 cm. below the mental prominence. It is to the auricular portion (Fig. 8) of this "Scheitel-Ohr-Kinnlinie," as it is called by the German anatomists, that the greatest interest attaches, and although through the dissection methods, to which reference will be made later, the trigeminal area has with considerable agreement been made to include a certain portion of the helix together with the

skin-fields of the separate divisions do not run to the mid dorsum. Thus the field of the N. mandibularis does not entirely separate the fields of the 1st and 2d trigeminal divisions from the cervical fields and though its auriculo-temporal branch would suggest an analogue with the posterior division of the spinal nerves, it fails to reach the mid dorsal line.

tragus, scant mention seems to have been made, even by anatomists, of the extension of the field into the external auditory canal. It is difficult at times to demonstrate the exact outline unless the meatus be large and in some cases it may be necessary to clip away the hair from the tragus before a satisfactory examination can be made. The deeper portion of the canal, together with the drum, is best examined through an aural speculum. As a rule the tactual anæsthesia of its upper and anterior walls may be easily demonstrated. The patient usually will hear the horse hair when it impinges upon the surface, although the unpleasant tickling sensation which follows upon touching the postero-inferior wall of the canal, just as in the normal ear, is not called out. The drum itself,

FIG. 6.

ordinarily exquisitely sensitive, is as a rule anæsthetic to a greater or less extent. In one patient it was found that the tympanum (to all appearances normal) was divided by the handle of the malleus into an anterior and upper anæsthetic portion, touching which with a horse hair gave only a loud rapping noise without tactual impression, and into a posterior acutely æsthetic portion touching which occasioned pain. Dr. Randolph was kind enough to corroborate the results of this finding and was able through his greater skill in intra-aural examinations to accurately map out the boundary line. In other instances I have not succeeded in so clearly demarcating the two fields on the tympanum. It has seemed, in some cases, together with the deeper portion of the posterior wall of the canal to be entirely without tactual sensativity. It may be said, however, that in the great majority of all cases the crus of the helix and the tragus, together with the anterior wall of the auricular canal, represent a point of anchorage, as it were, where the cutaneous lines of tactile anæsthesia are

buoyed, no matter at what angle they may be swept away from this point by the shifting of the skin over the developing mandible and cranium. (Compare the series of diagrams, Figs. 26-30.)

The anterior of the two lines is much more simple in its configuration and needs no description other than that which the diagram (Fig. 1) itself gives. It for the most part lies parallel to the crown-ear-chin line from which it diverges most widely at the crown and ear and approaches most closely at the temporal region, cheek and chin. Occasionally it also bellies out toward the tragus, though it usually bridges across this auricular irregularity in contour of the posterior line with no attempt at parallelism.

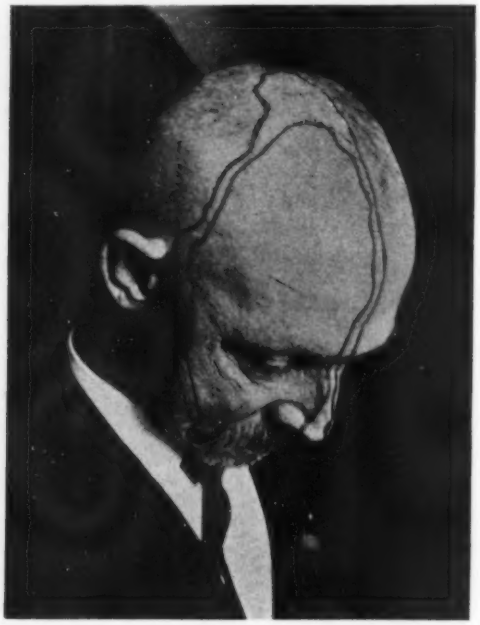

FIG. 7.

FIGS. 5–7.—Photographs showing combined areas of analgesia and tactual anæsthesia ten days after operation.

Variations from the Normal Type.—As has been stated, the above description applies to the posterior cutaneous boundary in the great majority of the cases observed and the variation in outline from case to case is no greater than might be expected from individual differences in the configuration of the underlying skull. In three instances, however, out of the twenty-six there was found an outline possessing somewhat different characteristics, and being alike in all three it may justly be regarded as indicative of a separate type of distribution. In these cases, as in the above, the same double lines were demonstrable. They were, however, set back so that the more anterior corresponded approximately with the more posterior of the normal type, that is, with the line described above in detail, whereas the more posterior of the two included within its boundaries the upper half of the pinna, the antihelix and its crura, a portion of the concha and a considerably greater share of the cheek. This variation is best shown by the photographs of the three cases[5] (Figs. 9-11). I have seen one case also, though only one, in which the outline corresponded with the field which Frohse, through the dissection method, has given as the average type (cf. Fig. 23) and in which the ascending portion of the helix, together with the fossa of the antihelix (fossa triangularis), are included.

The median boundary of the anæsthetic area, determined by tactual stimuli (horse-hair test), corresponded in all cases exactly with the mid-line of the crown, forehead, nose, lips and chin. There is detectable, however, as in the case of the posterior boundary, a very narrow border strip broadening out slightly at the root and tip of the nose, within which painful stimuli are interpreted as touch or pressure; analgesia as such, however, reaches, as does tactile anæsthesia, to the mid line. This is best appreciated by the examination of those cases in which the trigeminal neurectomy has been performed as the first operation, that is, when it has not been preceded by peripheral operations perhaps often repeated. In the latter cases the slight functional overlap, which time has allowed to take place, from across the mid line and from adjoining posterior fields, may accentuate the width and the sentiency of this border zone, though this is not always the case.

FIG. 8.—Outline of the auricular portion of the trigeminal field determined by the line delimiting tactual anæsthesia.

[5] There is one peculiarity in regard to the stability of these boundary lines that may be mentioned here since in one of these three cases it was more pronounced than in any of the other patients I have examined, although as a matter of fact it is observable to a greater or less degree in all. This consists in a rhythmic shifting of the lines of anæsthesia. If, for example, the line of tactile anæsthesia over the side of the scalp be rapidly marked out, the patient responding promptly the moment he feels the touch of the hair as it passes on to the area of æsthesia, it may be found after a few moments, should a second examination be made, to corroborate the line, that it has shifted backward perhaps one or two cm. A short time later it may again be found at its original position, and so on. One of the patients,

Before considering the intrabuccal field of anæsthesia it may not be out of place here to compare the above results with the observations made by others, notably by Krause, on this cutaneous field. Relative to six of the cases which form the basis of his earlier (1896) report upon a series of ganglion extirpations, are careful notes in regard to the post-operative anæsthesias. One of his photographs I take the liberty of copying here in outline (Fig. 12), inasmuch as it has found its way into several text-books of anatomy and neurology, having been accepted by the authors as the normal outline of functional anæsthesia after a trigeminal neurectomy. The figure represents the findings of an examination four weeks after the operation. The chart accompanying it shows that all forms of sensation in the areas A and B were at the time of observation abolished (aufgehoben); in C, D and E, greatly reduced (stark herabgesetzt), and and F slightly so (wenig

FIG. 9.

herabgesetzt). Doubtless the partial anæsthesia in the areas of the second and third division in this case have some relation

an intelligent observer of his own sensations, told me that he was himself aware of this slight contraction and expansion of the field of anæsthesia and that it occurred usually with a definite rhythm. It was noted, furthermore, in this same individual that when a watch was placed at a distance at which its ticking could barely be heard, the sound became plain and then scarcely or not at all audible with the same rhythm as that which affected the change in size of the anæsthetic field. It was then easily demonstrable by attaching to the patient's arm a blood pressure apparatus that a slight rise in systolic pressure of six to eight mm. of Hg. corresponded with the period of more acute hearing as well as with that of shrinkage of the anæsthetic field. When sleepy or fatigued the field of anæsthesia was broadest and evidence of the fluctuation of the boundary was no longer apparent.

Such a shifting is doubtless explicable on physiological grounds and although it occurs but rarely to any great extent, it nevertheless must be borne in mind by those making the tests lest it be the occasion of confusion. In the cases in which the rhythm was definite I have endeavored always to plot the posterior of the lines.

to the many preceding peripheral nerve resections on these branches, the first of which on the inferior maxillary had been performed as much as thirteen years before the ganglion operation. A later observation (2¼ years) on this same patient showed considerable shrinkage, especially in the territory of the first (ophthalmic) division, together with partial return of common sensation in the supraorbital region and a shrinkage of the area away from the median line. In some others of Krause's earlier cases it seems evident from the description that the ganglion cells, particularly of the ophthalmic division, had not been completely removed since sensory perception of the supraorbital territory was relatively so little affected. In two or three of the cases in my series a similar

FIG. 10.

return of more or less complete sensitivity in the ophthalmic division has taken place. These were cases in which from operative difficulties a complete enucleation of the ganglion with evulsion of the sensory root was impossible. In one of them not only was there a partial return for sensations of pain and touch in the area of the ophthalmic division, but also painful stimuli over the cheek gave impulses interpreted as touch or pressure (area of N. infraorbitalis). The lower two-thirds of the ganglion with the intracranial portions of the N. maxillaris and N. mandibularis were certainly removed in this case and the ophthalmic portion sufficiently broken up to render its territory completely anæsthetic for some weeks. It is presumable that in the fragment of the ganglion left at the operation, cells remained which finally re-established connections not only with the traumatized ophthalmic division, but also in part with the severed N. infraorbitalis. Inasmuch as those cases, in which the ganglion with its sensory root has been removed in its entirety, have had no return of sensation other than an insignificant shrinkage of the border areas of the entire field, it seems much more probable that the partial

return or persistence of sensation in these cases represents the passage of impulses by way of the partially restored trigeminus rather than by an extensive functional overlap with the cervical fields. Zander has attempted to explain the post-operative sensativity of the ophthalmic field in some of Krause's cases by the supposition that the occipital nerves may at times extend forward as far as the palpebral cleft. From the diagrams of resultant anæsthesia, I would be inclined to put the former interpretation, namely, that of incomplete extirpation, upon one of Friedrich's carefully studied cases.[5a]

It will be noticed in Krause's diagrams that although the margin of anæsthesia approaches the ear, it does not include the tragus and doubtless there was no intent to more than roughly indicate the outlines of the trigeminal divisions. This

Fig. 11.

Figs. 9–11.—Photographs of the three instances of variation from the normal distribution. Patients ten days after operation. Anterior line, analgesia; posterior line, tactual anæsthesia.

is the more apparent since he briefly mentions the insensativeness of the anterior wall of the canal in its external portion and comments in the context upon its inclusion in the trigeminal field since two of his patients found in cleaning their ears with "einem kleinen Löffelchen" that they were apt to occasion pain, owing to the insufficient protection of an anæsthetic meatus, by carrying their "Reinigung" too deep, even to the sensative drum. This occurred in one case as late as two and one-third years after the operation.

Krause's observations led him to accept the view of double innervation for otherwise "müsste ja nach Ausrothung des Ganglion Gasseri das gesammte Trigeminusgebiet volkommen anästhetesch sein: unsere Untersuchungen lieferten ober ganz andere Ergebnisse." He explains the variability of his findings on anatomical grounds, a belief to which the investigations of Frohse and Zander seemed to give support.[6] It is much to ge regretted that Krause in his more recent paper has not added to the physiological notes which accompanied this earlier work, since a larger proportion of the later cases have been doubtless more perfect extirpations, and what is more important, have, some of them, been carried out on patients in whom no previous peripheral neurectomies had been performed. It is from such uncomplicated cases especially that the most satisfactory data may be obtained.

2. *Outline of the Mucous-Membrane Field.*—The boundary of the intrabuccal field of anæsthesia may be traced, as has been the skin-field, by beginning at a given point, and for this purpose the muco-cutaneous junction of the lower lip may be conveniently chosen. The line of anæsthesia (Fig. 13) to all forms of sensation corresponds exactly with the mid line of lip, frænum linguæ, tip and dorsum of tongue as far back as a point slightly anterior to the foramen cæcum;

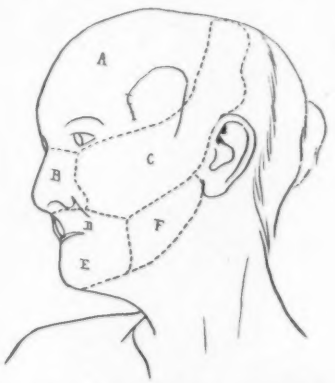

Fig. 12.—Krause's "Beobachtung 3." Showing the results of an examination four weeks after a ganglion extirpation.

thence it passes outward along the row of circumvallate papillæ to the lateral root of the tongue where there is some variation from case to case, though in the majority of instances it passes along the palato-glossal fold, to the upper portion of the anterior pillar of the fauces (Arcus glossopalatinus) which it follows to the uvula. The posterior pillar (Arcus pharyngopalatinus), so far as I have observed, together with the tonsil

[5a] Friedrich. Deutsche Zeitschrift für Chir., 1899, Bd. 52, p. 360.

[6] A case has been reported by Drs. Spiller, Keen and Dercum in which the ganglion was removed, together with an endothelioma of the neighborhood and in which there was only slight consequent hypæsthesia of the face. On physiological grounds it is difficult to conceive of such a condition and that the facial nerve should assume the sensory function of the trigeminus even in an anomalous case seems from a morphological standpoint quite improbable. It is enough to startle the shades of Majendie and Charles Bell into remonstrance. The writer has twice operated on cases of basal tumors involving the Gasserion ganglion (once an "endothelioma" and another time a chondrofibroma) and although the tumor in each instance was entirely extradural and to all appearances occupied the entire Cavum Meckelii, leaving apparently no trace of the second and third rami or of their foramina, only partial anæsthesia resulted from the attempted extirpation of the growth.

and the lower or vertical portion of the anterior pillar, retain their sensation and developed as they are from the parts posterior to the mandibular arch, are supplied, as would be expected, by the glossopharyngeal nerve. Whether the nasal and pharyngeal areas of anæsthesia are cut off from this intraoral field by an æsthetic strip on the roof of the soft palate, from my observations cannot be stated positively, and although there is an overlap here which will be described later, it seems probable that the trigeminal fields of intraoral and nasopharyngeal distribution do so communicate. If this be the case, the line, to continue with its course, curves around the soft palate near its junction with the uvula, gains the roof

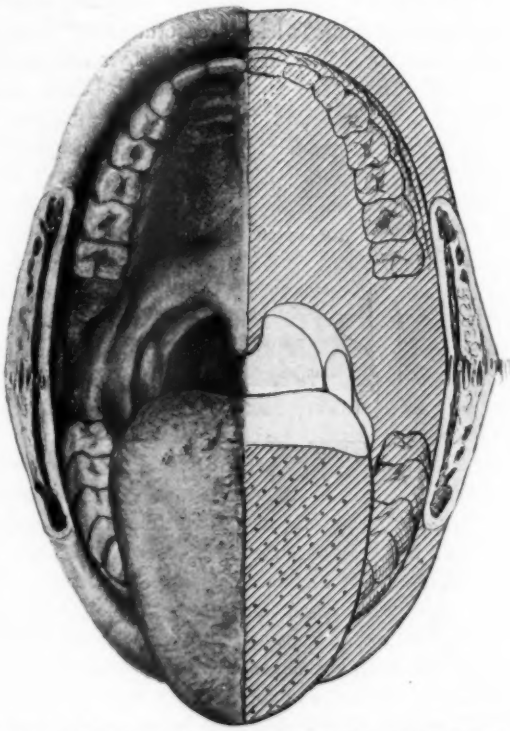

FIG. 13.—Diagram of intrabuccal anæsthesia. Other mucous surfaces, the Schneiderian membrane, dorsum of palate, root of pharynx and half of Eustachian orifice (?) are also without sensitivity.

of the velum across which it passes to the lateral pharyngeal wall; thence upward, dividing in its course the pharyngeal ostium of the Eustachian tube, proceeding thence to the mid line of the vault of the pharynx; from here it pursues again a median path along the internasal septum, keeping in the mid line of soft palate and uvula, both dorsal and ventral surface, hard palate, gums and upper lip to the muco-cutaneous junction again.

With the exception of the tongue, as will be described, the entire mucous field within these lines is rendered completely devoid of sensation by the neurectomy: the lips, teeth, gums, anterior two-thirds of the tongue, cheek, hard and soft palate, uvula, a portion of the pharyngeal vault, together with the entire Schneiderian membrane on one side. Instruments may be introduced into and through the nasal chamber, the patient being unconscious of their presence. The sneezing reflex is abolished, as well as the gagging reflex produced by irritating the soft palate on the side of anæsthesia. The fumes from ammonia, ether and like substances are no longer irritating when inhaled, the irritant quality acting apparently upon the nerves of common sensation alone and not upon these of special sense, for the latter remain unaffected. Some interference with the sense of smell has been described in these cases, but it is probably due to the fact that an abnormal dryness of the mucous membrane persists for some time after the operation and interferes somewhat with the acuity of the sense of smell, for, especially if the membrane be moistened by a saline irrigation, the special sense perception seems equally acute on the two sides.

One portion of this mucous field, owing to its inaccessability, has been less satisfactorily examined than the remainder. This is the field occupying the vault of the pharynx. One observation, however, that has in all cases yielded like results, shows the normal sensitivity of the Eustachian orifice to be much diminished. A Eustachian catheter may be passed through the nares on the anæsthetic side unknown to the patient and be introduced into the ostium of the tube, where it produces very slight if any sensation, provided it is held away from the outer side of the orifice and does not enter the fossa of Rosenmüller.

This observation may be controlled as follows: If the æsthetic mucous membrane of the other nares is cocainized so that the catheter may be similarly introduced without the patient's being aware of its presence, the usual disagreeable sensation is produced the moment the instrument comes in contact with any part of the Eustachian orifice. So far as my observations go, it also seems that the vault of the pharynx above and anterior to the ostium is likewise anæsthetic for tactual stimuli. Examinations of this sort through the nares without direct visual supervision of the points of contact is, of course, open to criticism, and without great success I have attempted to corroborate the findings by tests carried out through the mouth with the aid of a laryngoscopic mirror. Only in exceptional instances has this been possible. The main point, however, which it is desired to emphasize is that the pharyngeal opening of the tube, like the external auditory canal, is probably innervated on its anterior (cephalad) half by the trigeminus and posteriorly by the next adjoining cranial nerve having afferent splanchnic fibers, glosso-pharyngeus or vagus.

After a trigeminal neurectomy that portion of the tongue anterior to the circumvallate papillæ is an exception to the rule of total anæsthesia to all forms of stimuli. Simple tactual impulses produced with a horse hair, as well as those of pain and temperature, are completely interrupted exactly to the mid line. Certain forms of common sensation are, however, preserved. If a cotton swab or a wisp of cloth be moved over the anæsthetic field, its presence is recognized, localized more or less accurately, and its direction of move-

ment appreciated. There are reasons for believing that certain fibers from this area of the tongue not only as the special sense fibers of taste but also of common sensation, pass to the brain by way of the Chorda tympani and the Nervus intermedius (Wrisberg). This question has been entered into more fully in a previous communication[1] concerning the course of the taste fibers. Reasons for believing that the paths for taste fibers were largely, if not entirely, independent of the trigeminus, as well as for believing that some other fibers of common sensation passed together with them from the anterior two-thirds of the tongue were then given. Since writing that paper additional opportunities in seven cases have sufficed to further strengthen the conclusions therein set down. In none of these cases was taste affected in the slightest by the operation; in all of them there was retained over the anæsthetic portion of the tongue this peculiar form of sensitiveness to certain tactual stimuli. An examination, furthermore, of a number of cases of facial palsy, has shown that when the lesion is high enough to interrupt the transmission of gustatory impulses there is an accompanying slight sensory disturbance over the anterior portion of the tongue to these particular forms of stimuli, even though a normal sentiency to touch pain and temperature seems to be present. Thirdly, the good fortune of being enabled to observe a patient in whom both the fifth and seventh nerves were totally paralyzed has shown that no sensation whatever over the anterior part of tongue remained to touch, taste, pain, temperature or to the movement of a swab over the surface. These observations have been sufficient to establish from a clinical basis a personal conviction that there exist afferent fibers of two sorts, common and special sense fibers, which pass from the tongue via the chorda tympani and N. intermedius. It may be seen that morphological studies are in agreement with this.

3. *Disturbances of the So-called "Muscular Sense."*—Comment was made by Charles Bell upon the apparent slight palsy of the muscles supplied by the facial nerve that followed operative or experimental section of the peripheral branches of the trigeminus. Thus, for example, a slight droop of the upper lip with planing out of the naso-labial fold could be observed after section of the infraorbital bundle of the trigeminus. Sequelæ of this sort have since been frequently observed by surgeons after peripheral neurectomies of branches of the fifth nerve and are commonly ascribed to associated injuries of terminal twigs of the facial or to division of fibers of the muscles themselves. Postural deformities of any consequence, such as usually appear in the region of the eyebrow after the customary ganglion incision, are of course due to such an injury of the nerves to the frontalis, corrugator supercilii, and possibly in part to the orbicularis itself. Quite another matter are the phenomena of senso-paralysis which may oftentimes be observed in these patients, though they might not attract the casual glance.

In the period immediately following the neurectomy there may be seen, more marked in some cases than in others, a not inconsiderable hemilateral flaccidity of both upper and lower lips and possibly, as Krause has remarked, a slight flattening of the ala nasæ and lessening in depth of the naso labial fold, a condition somewhat emphasized by the temporary fullness of the tissues due to the vasomotor paralysis. At rest, with the lips closed, the lip margins on the operated side tend in some cases to remain slightly parted; during active movements the asymmetry between the two sides may become somewhat more pronounced, for example, in the effort to whistle when the lips may not be satisfactorily puckered. In one of my cases for a few weeks the postural disturbance was so great as to simulate an actual hemifacial palsy, and only after electrical examination could it be proved otherwise. At a later period the flaccidity is frequently replaced by a corresponding degree of overaction in the expressional musculature, namely, by a slightly drawn position of the corner of the mouth, a deepening of the naso-labial fold, and in old people an accentuation of the wrinkles (crow's foot) radiating from the outer canthus. The principle underlying this phenomenon is of quite a different nature and the overaction is never as marked as in contracture of the muscles during recovery of a true motor palsy. There is not uncommonly seen also a slight "tic" or twitching of the muscles, for instance in those comprising the orbicular or naso-labial group. Of this the patient is unconscious. It must be said that all of these phenomena may be so inconspicuous as to be readily overlooked and in some cases may not be observed at all.

The complete absence of postural sense may, however, be easily demonstrated in another way. It has been noted above that faridization is one of the most satisfactory methods of mapping out the field of anæsthesia, the patient being unaware of the contact of the electrode until it crosses the boundary onto the æsthetic area. If the current be strong enough to elicit contractions in the groups of muscles about the eye, nose or mouth, the movements are not appreciated, provided the patient's eyes be closed so that they cannot be observed, and also provided the twitch be not transmitted to the opposite or æsthetic side of the face. Similarly, passive movements produced in other ways, as by hooking up the ala of the nose or corner of the mouth, are unaccompanied by recognition of the changed position.

The loss of muscle sense may likewise be in a measure responsible for the post-operative postural asymmetry of the tongue and soft palate, though I have been inclined to largely account for the condition in another way. During the operative procedure the motor root of the fifth is almost of necessity sacrificed with resultant unilateral paralysis of the masticatory muscles. Consequent upon the loss of function of the pterygoids, the lower jaw, when the mouth is widely opened, deflects toward the paralyzed side and the protruded tongue remains in the mid line of the deflected jaw, doubtless gaining its sense of position from the posterior attachments to the inferior maxillary bones. The base of the tongue retains, of course, its normal sensitivity and the loss of muscle

[1] The Taste Fibers and their Independence of the N. trigeminus. The Johns Hopkins Hospital Bulletin, Vol. 14, 1903, p. 71.

sense affects the muscle bundles of the anterior portion on one side only. Many patients have some difficulty in placing and especially in retaining the tip of the organ in the mid-line position even of the deflected jaw.

The post-operative asymmetry of the palate, to be discussed more at length elsewhere, may also be attributable in part to disturbances of muscle sense, though I have ascribed it as due chiefly to the paralysis of the tensor palati (M. tensor veli palatini), which has a motor fifth supply. The degree of postural deformity varies greatly in different individuals. The patient in whom of all the cases it was most marked, a preacher, was the only one to appreciate any inconvenience therefrom. When talking rapidly in delivering an address he finds that the palatal sounds are less distinctly enunciated than formerly. In conversational tones this is not apparent.

Other than the transient paralyses of the ocular muscles attributable to a definite cause, namely, to pressure of the instruments against the third, fourth or sixth nerves during the operation, I have never observed any ataxia or postural disturbance of movement in the eyeball consequent upon the neurectomy. It is quite possible that these muscles receive their sensory innervation from another source than the fifth cranial.

4. *The Sensory Supply of the Dura Mater.*—Since the time of Haller's experiments the dura has been recognized as a sensitive membrane. So far as the writer's operative experience goes, it is less acutely so in man than in some of the lower animals; in dogs especially, even when under deep narcosis, a great "pressor" response through the vasomotor center may be reflexly elicited even by slight dural manipulation. The same reaction occurs in man, though seemingly to a less degree. After a trigeminal neurectomy the dura, so far as it is exposed by the cranial opening, is rendered anæsthetic. In a case of basal tumor recently operated upon and in which the ganglion and its trigeminal root were removed along with the larger part of the infiltrating growth, the wound was left open to allow of direct application of the X-rays. The large area of dura of the middle fossa and temporal region thus exposed was found after the operation to be totally without sensitivity.

There is one post-operative symptom, which in a certain proportion of the cases of Gasserion ganglion extirpation has been observed with great regularity. During the later stage of the operation when the superior envelope of the ganglion has been elevated sufficiently well to expose the trigeminal root, an escape of cerebro-spinal fluid almost invariably takes place. In certain cases also, in which there is more than the usual degree of bleeding after extracting the ganglion, it is necessary to insert a drain for two or three days, the cerebro-spinal fluid continuing to escape for as many days as the drain remains. This seemingly is the occasion of the dull post-operative headache which chiefly in these drained cases may characterize the first few days of convalescence. The headache, however, in a case of total extirpation is invariably a unilateral one and referred to the sound or unoperated side of the cranium. The same peculiarity remains a feature of the headaches which during subsequent months may be occasioned by one cause or another, such as chance disorders of alimentation. Only on the few occasions in which the extirpation has been incomplete, owing to operative difficulties, and the ophthalmic division with its fragment of the ganglion been left in situ, have these post-operative intracranial discomforts been bilateral. In these cases of partial extirpation, of which there have been two in my series, the sensitivity over the skin-field of the ophthalmic branch has been only affected in part and it is presumable that the filaments to the dura from the same division likewise continue to transmit impulses.

The hemicranial nature of these symptoms in cases of total extirpation points very strongly toward a dural origin for many forms of headache, and offers, furthermore, an interesting suggestion of the relationship between trigeminal neuralgia and its frequent precursor, migraine.

The following quotation from a standard text-book of anatomy will show that in the minds of some there exists some doubt as to the sensory innervation of the dura. "Minute nervous filaments, derived from the fifth, tenth and twelfth cranial nerves, and from the sympathetic, enter the dura mater of the brain to be distributed chiefly to the blood vessels and to the bone, but *partly perhaps to the membrane itself.*" Others, however, consider the nerves to be unquestionably sensory. The more important of them, as described by Arnold and Luschka, are the recurrent nerve (N. tentorii) from the ophthalmic division, the recurrent nerve of the superior maxillary division following the meningeal artery and its branches, and two recurrent nerves from the mandibular division, one to the middle fossa and a small branch to the occipital dura, entering the condyloid fossa with the hypoglossal. Charpy, in an excellent chapter on the "Coverings of the Central Nervous System,"[1] sums up the matter as follows: "Comme on le voit, si on excepte le rameau du pneumogastrique et quelques filets émanés des plexus sympathiques périvasculaires, c'est le trijumeau qui fournit la tolalité des nerfs propres de la dure-mère."

5. *Sensory Outline of Adjoining Skin-fields.*—Extensive operations on the neck, in which the ventral cutaneous branches of the second and third, or even of the second, third and fourth cervical segments are sacrificed, serve to isolate the trigeminal skin-field within an enclosing area of cutaneous anæsthesia. An opportunity is thus given, by comparing the anterior outlines of the anæsthetic field so produced with the posterior outlines of the anæsthetic field resultant to a trigeminal neurectomy, of determining the extent and character of functional overlap between these adjoining areas.

The cases which have for the most part best served this purpose have been those of complete extirpation of the cervical glands (Figs. 14-15), though operations of other sorts necessitating peripheral nerve divisions have also furnished material for study. The anæsthesia occasioned by these lesions is a

[1] Poirier et A. Charpy: Traite d'Anatomie Humaine, 1901, Tome III, Systeme Nerveux, p. 96.

much less permanent one than that in the trigeminal area after division of the root of the fifth nerve, and consequently it is advisable to determine the outlines as early as possible

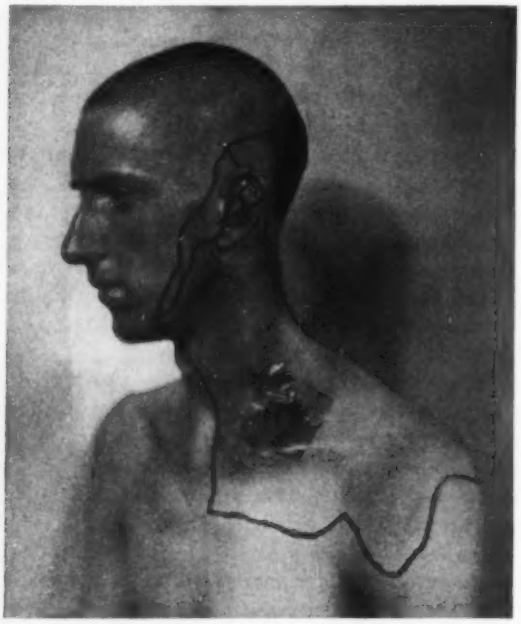

FIG. 14.

after the operation. Most of the areas have been plotted from the seventh to the tenth day, that is, as soon as the surgical dressings would allow of an exposure of the parts.

FIG. 16.—Average outline of the auricular portion of the cervical field delimiting the area of tactual anæsthesia.

As in the study of the trigeminal field, so here chief stress will be laid upon the outlines related to the ear. The line delimiting tactual anæsthesia (horse-hair test) (Fig. 16) in the large majority of cases studied lies on the temporal region somewhat farther back than the tactual line of the trigeminal field, strikes the pinna at about its upper mid portion, ascends over the edge of the helix to the outer face of the

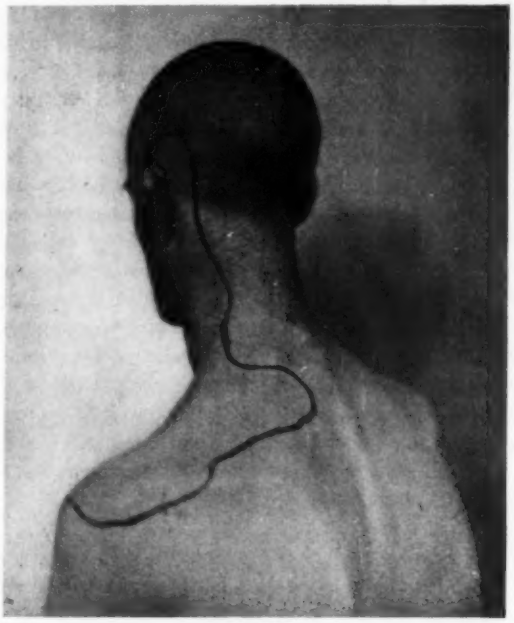

FIG. 15.

FIGS. 14 and 15.—Area of transitory anæsthesia after extensive 'glands of the neck' operation with sacrifice of ventral branches (CII, III and IV) of the cervical plexus.

ear, which it crosses behind the fossa triangularis to the antihelix; the ridge of this latter structure it follows, passing around the posterior margin of the concha to the in-

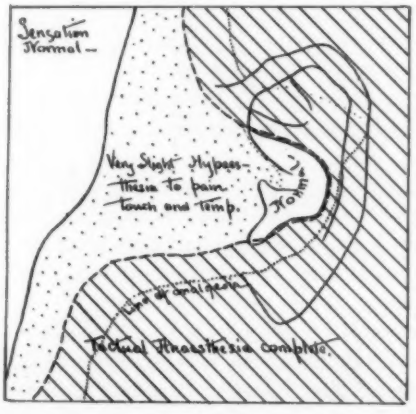

FIG. 17.—Charted 8 days after 'glands of neck' operation. Boy of 12. Showing medium (average) vagus area.

cisura intertragica, the line usually dipping in somewhat on the inner face of the antitragus; from the incisura intertragica, 5 mm. or more below the point of emergence of the trigeminal line for touch, it passes out onto the cheek usually

in a forward and downward direction instead of forward and upward as does the trigeminal line.

The line of analgesia and thermo-anæsthesia lies from a few mm. to about one cm. posterior to this tactile outline.

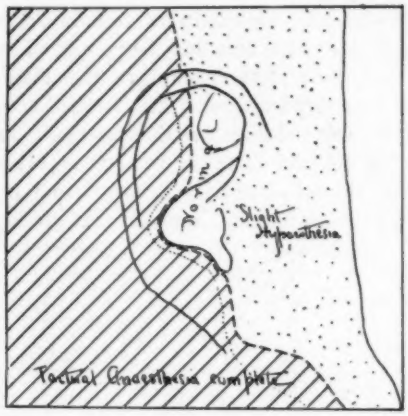

FIG. 18.—Eleven days after 'glands-of-neck' operation. Girl of 20. Large vagus area.

There can be detected, also, in almost all cases, a clear-cut boundary on the cheek which corresponds with the anterior of the lines described with the trigeminal field and within which there is an appreciable though exceedingly slight hypæsthesia to all forms of sensation, to pain, touch and temperature.

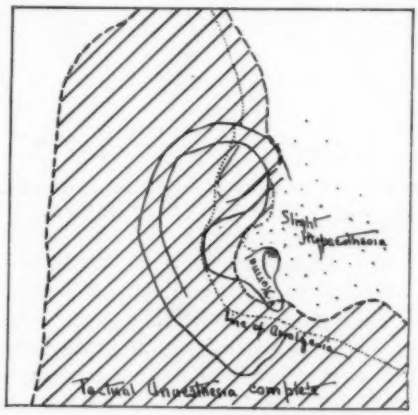

FIG. 19.—Eight days after 'glands-of-neck' operation. Small vagus area.

FIGS. 17–19.—Show areas of "remaining æsthesia" in fields of trigeminus and vagus after section of cervical nerves (N. auricularis magnus and N. occipitalis minor).

Shaded area, within broken line = field of tactual anæsthesia.

Dotted area, within solid line (Figs. 17 and 18) = field of slight hypæsthesia to pain touch and temperature.

Dotted line delimits anterior margin of analgesia.

These several outlines may be better appreciated by the three drawings (Figs, 17, 18 and 19), which give at the same time some of the variations seen in this area.

It will be seen, in Fig. 17, that the outline of tactile anæsthesia of the cervical field, with the exception of the concha, presents almost an exact negative of the corresponding line of the trigeminal field. This has been observed in several cases. A photograph of the outline of one of them is here given (Fig. 20), a case in which the posterior root ganglia of the second and third segments on the left side were removed from the intervertebral notches for intractable neuralgia of this region.

The concha itself, wholly or in large part, as will be seen, retains its normal sensitivity, and together with the posterior wall of the external auditory canal it represents a field of distribution interposed between the trigeminal and cervical areas. It has been generally conceded by anatomists that this area is supplied by the peculiar aberrant cutaneous branch from the vagus, the R. auricularis nervi vagi of Arnold.

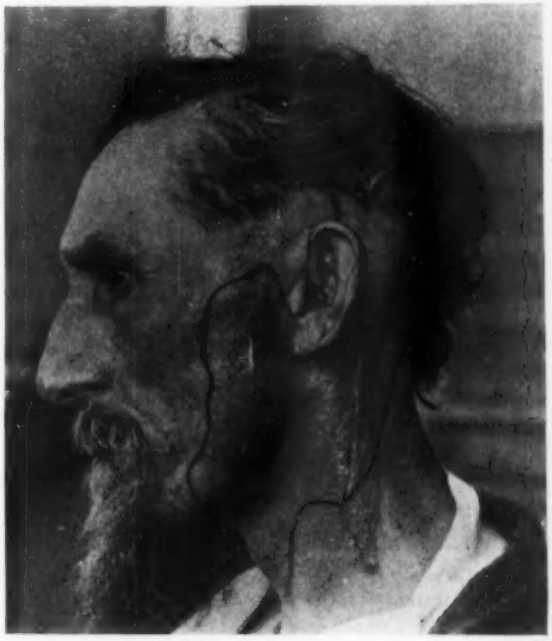

FIG. 20.—Segmental area of tactual anæsthesia after removal of 2nd and 3rd posterior root ganglia.

6. *Overlapping and Permanence of Anæsthesia.*—What has been said in the preceding section will have shown that the overlap between the skin fields of the trigeminal and cervical areas is less extensive and functionally less perfect than anatomical and experimental evidence would have led one to expect. If, as seems probable, the strip of hypalgesia (Fig. 1) is to be taken as representing the overlap on to the trigeminal field from the area of C II, it not only is possessed of very slight sensativity in the early post-operative period but also, so far as I have been able to learn from the examination of late cases, never returns to anything like its normal condition of æsthesia. In only seven cases of the ganglion series has it been possible to make comparative examination after long periods of time: one of them a year, two eighteen months, three two years and one four years after the operation. In all of these cases, with two exceptions, the old outlines

have still been clearly demonstrable, the only change being that of slightly increased sensativity in the strip of overlap, though it remains considerably below a normal condition of æsthesia. The two exceptions were as follows: one, an incomplete extirpation in which sensation with some hyperalgesia had largely returned in the territory of the ophthalmic division, the other, one of the group constituting the trigeminal subvariety (Fig. 9) and, though a complete extirpation, there had been after two years a shrinkage of the field to the normal or average configuration (Fig. 21) a finding which would have served to make one somewhat skeptical of the accuracy of the original outlines had they not been carefully and repeatedly plotted. This, too, was one of the cases in which the rhythmic shifting of outline mentioned above had been especially evident, the most post-

FIG. 21.—For comparison with Fig. 9. Areas of anæsthesia to pain and touch two years after the neurectomy.

axial position of the line having been photographed in the original. In many of these late examinations on account of the growth of hair I have felt less certain of the persistence of the original lines on the scalp though in this case (Fig. 9 and 21) and in one other, owing to baldness, it was possible to trace them to the longitudinal line of the crown.

The median or crossed overlap, from the opposite side, after the lapse of time remains likewise insignificant and physiologically incomplete, it being possible to demonstrate tactual hypæthesia to the mid-line after years, in spite of the slight increase of sensativity which appears especially in the nasal portion of the mesial strip.

The same is true for the mid-line of the mucous membrane field where the functional crossing is trifling. One portion of the intraoral field, however, in several cases seems to have largely regained its sentiency, namely, the anterior pillar of the fauces, the uvula and the margin of the soft palate. It is this return of sense perception along the velum that has thrown some doubt upon the communication, mentioned above, as a probable one between the pharyngeal and oral portions of the trigeminal territory.

What has been said applies only to the overlap from the adjoining areas on to the trigeminal field in conditions of trigeminal neurectomy. In the cases of cervical nerve lesion the almost complete restoration of normal anæsthesia has probably been due to the fact that the peripheral nerves alone have been sacrificed and nerve reunion rather than trigeminal overlap has been responsible for the return of sensation. In one only of the cervical cases was the anæsthesia due to a root division (Fig. 20) and there has been no opportunity of examining this patient since his discharge from the hospital. I am inclined to the opinion, however, that overlap from the

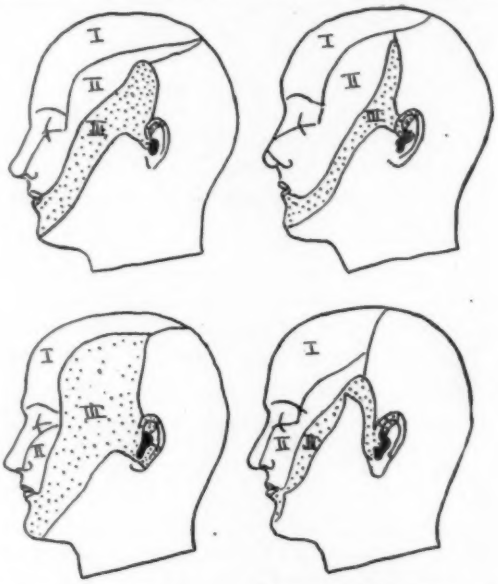

FIG. 22.—Frohse's four types of trigeminal distribution. Field of mandibular division is dotted. Vagus field solid black.

trigeminal onto the cervical fields is functionally less than from the cervical onto the trigeminal, for the slight though appreciable dulling of sensation along the posterior edge of the trigeminal area immediately after the cervical lesions (Fig. 17-19) shows the anterior limit of cervical distribution, surprising though it may be that one is able to demonstrate overlap in this way. It is not impossible, however, that what I have considered as a subvariety of the trigeminal area (Figs. 9-11) may be nothing more than the corresponding overlap onto the cervical field, demonstrable immediately after the trigeminal lesion and sufficiently noticeable in three cases only though possibly present in inappreciable degrees in all.

The anterior or posterior overlap from the auricular skin-field innervated by the vagus, if present at all, seems to be inconsiderable.

II. Anatomical Results Given by the Dissection Method.

We may now for purposes of comparison turn briefly to

the consideration of the results obtained by other methods than the clinical one. Those anatomists who have made this area the object of particular study, notably Frohse and Zanger, have devoted their attention largely to the cutaneous distribution. Their painstaking labors seem to have indicated that the variation in outline of the main field, from case to case, is considerable and particularly that the extent of the fields for the three trigeminal subdivisions shows great individual differences; that even in the same individual the distribution on the two sides of the face may be very different; that there is a wide anatomical overlap, "Verbreitungsgebiet," between the adjoining fields; and, Zanger, especially, that it is possible by careful dissection to demonstrate fibers crossing the mid-line, more noticeably at the nose and lips. They have both emphasized the absence of trigeminal fibers to the skin covering the parotid and masseteric areas, a condition which had escaped the notice of their predecessors, and, may I add, of many of their followers. Frohse in his elaborate monograph[9] gives not only the variations which he has found, but compares them with the fields delineated in the familiar diagrams of Strümpell, Merkel, Landois and others. In Fig. 22 are given four types of skin-fields as his personal dissections have led him to picture them,[10] the first of which, inasmuch as it corresponds with the diagram which he had furnished for Krause's (1896) monograph (cf. also Frohse's outline in Fig. 23), I take to represent the average type as he has found it. His four figures all illustrate well the "anchorage" of the field at the external auditory meatus. Excepting the inclusion of the helix about to its mid summit, as well as the fossa of the antihelix, a distribution which I have found to be functionally demonstrable in one case only, the outline in this first figure is practically the counterpart of the skin field demarcated in the great majority of my cases. Frohse also emphasizes the presence of the vagus field its area being somewhat variable in extent though largely confined to the concha.

FIG. 23.—Posterior boundary of the trigeminal skin-field as given by various anatomists.

In Fig. 23 a composite has been made of the trigeminal outlines given in some of the standard anatomical works. Many more types might have been added for there are a great number of them, but these will suffice. Van Gehuchten,[11] it will be seen, gives merely a schematic outline within which the skin

[9] Fritz Frohse: Die oberflächlichen Nerven des Kopfes. Berlin-Prag, 1895.

[10] Bardeleben, Haeckel und Frohse: Atlas der topographischen Anatomie des Menschen. Dritte auflage, Jena, 1904.

[11] Anatomie du Système Nerveux. Troisième Edition, Louvain, 1900, Vol. 2, p. 150.

covering the parotid and masseter regions is included. Toldt,[12] incloses the vagus field together with the antitragus within the trigeminal area. Thane[13] gives a still more posteriorly placed auricular line which, like Toldt's, includes the vagus field and also most of the helix and antihelix, the outline corresponding closely with the field of the subvariety which has been mentioned as occurring in a small percentage of my cases. Other authors as Spalteholtz, following Zander,[14] have given a somewhat confused figure with indefinite outline, in their desire to represent the anatomical variations and overlap. Zander's diagram otherwise is for the most part in accord with Frohse's and his excellent article is given up largely to the consideration of anatomically demonstrable overlap.

In many of the newer anatomies, in spite of the omissions of detail in describing skin-fields, there will be found in the context mention of the finer distribution; as that of Arnold's nerve, of the branch from the auriculo-temporal to the external auditory meatus; of the filament to the tympanic membrane, etc. In Schwalbe and Siebenmann's monographs on the Ear[15] will be found gathered most of the available information in regard to the distribution about the external and internal ear, though I have not found even there comment on the supply to the Eustachian tube. According to Henle, however, certain branches of the superior nasal group from the spheno-palatine ganglion terminate in the neighborhood of the Eustachian orifice. The distribution of Arnold's auricular branch from the vagus has been traced with particular care by Frohse and interposed as it is between the auricular branches of the fifth cranial and those of the second cervical fields the possibilities of complex innervation of the external ear are great. As stated by Soulié[16] "c'est le pavillion de l'oreille qui, en raison des sources multiples de son innervation, présente les anomalies les plus fréquentes; c'est d'ailleurs à cette innervation complexe qu'il doit de conserver sa sensabilité presque indemne lorsqu'une de ses sources d'innervation vient à etre supprimée."

In consideration, therefore, of this multiple innervation, particularly of the auricle, and of the variability of field configuration shown by Frohse and the demonstrable overlap between the fields according to Zander, it is surprising how much conformity there seems to be in the clinical outlines in a comparatively large group of cases and how closely the tactual-line delineation of these cases corresponds with the average field determined by Frohse's dissections.

[12] Anatomisches Atlas, 1903.

[13] Quain's Anatomy, 10th Edition, 1895, Vol. III, Pt. II, "The Nerves."

[14] R. Zander: Beitrage zur Kenntniss der Hautnerven des Kopfes. Anatomische Hefte, 1897, Bd. IX, p. 1, Merkel's Festschrift Volume.

[15] Bardeleben's Handbuch der Anatomie des Menschen, Jena, 1897, Bd. V, Lieferung 6.

[16] Poirier et Charpy's Traite d'Anatomie Humaine. Paris, 1901, Tome 3, p. 834.

3. The Results of Animal Experimentation.

From the standpoint of physiological experimentation the investigations made by Sherrington[17] to determine the segmental skin-fields on the macaque are so far superior in extent and in accuracy of detail to any similar observations which have ever been made that for purposes of comparison with our clinical findings they alone need be referred to here. The method chiefly used was that designated by Head as the "method of remaining æsthesia" in which the extent of a given skin-field is determined, after the intradural section of two or three dorsal nerve roots adjoining, both on the cranial as well as caudal side, the particular root whose distribution was the object of study. In this way an æsthetic dorso-ventral strip of skin would be left in the midst of an anæsthetic field. It need hardly be repeated here that the experimental section of a single dorsal root, at least of the spinal segments, leaves no area from which tactual responses may not be elicited even though there may result only partial loss of sensitivity to some other forms of stimuli. This is due to the almost complete tactual overlap of a single dermatome by the nerve terminals from adjoining root fields, the condition for each unit being that of almost complete double innervation. I have had an opportunity of corroborating in man the accuracy of these laboratory findings in so far as they apply to one of the spinal segments, by the study of a patient in whom a dorsal root in the cervical region had been divided during the enucleation of a tumor of the meninges. This well recognized law of overlap seemingly does not apply in its full force to the cervico-trigeminal boundaries, nor to the field margins of the three trigeminal divisions. If we are to consider the N. trigeminus and its ganglion as representing a fusion of three sensory cranial units, the severence of peripheral connections with one of its divisions should not leave a tactually anæsthetic field. This is, however, not the case for section in man of the N. mandibularis alone for example, leaves an anæsthetic skin-field whose boundaries in the early post-operative period correspond with the anatomical distribution and with the physiological field which would be determined by the "method of remaining æsthesia." If the laws of functional overlap were here applicable the other divisions of the fifth and the second cervical fields would so encroach on this area as to mask its tactual outlines.

On section of the trigeminal root, it being the most anterior of the sensory nerves of the body, and overlap across the mid line being so slight, there naturally results a large area of anæsthesia, the field of double innervation only being possible at its posterior border. Sherrington found that such a trigeminal section in the monkey left a field of complete insensitivity within the anterior line shown in Fig. 24 c., which at the same time supposedly represents the anterior limit of functional distribution of the cervical segments. This line doubt-

[17] C. S. Sherrington: Experiments in Examination of the Peripheral Distribution of the Fibers of the Posterior Roots of some Spinal Nerves. Part II. Philosophical Transactions of the Royal Soc., London, Series B, Vol. 190 (1898), p. 45-186.

less corresponds for the macaque with the anterior of the lines determined in man (Fig. 1), and herein lies the chief difference between the experimental and clinical findings. It is almost impossible in dealing with animals to differentiate between the character of responses to the various forms of stimuli and all must be set down alike. Hence the entire extent of the trigeminal skin-field, after posterior root division, cannot be mapped out as it can in man by the employment of delicate tactual stimuli. Were communication impossible between the observer and the patient, as is the case in the laboratory experiment, the functional incompleteness of the overlap in man also would pass unobserved, since responses to pain (though not dolorous as stated above) may be elicited from the trigeminal posterior-border-strip. (Fig. 1).

After experimental division of the cervical nerve roots, Sherrington also determined a line representing the posterior border of functional distribution of the trigeminus which, although it includes in the diagram (Fig. 24b) the entire ear and is somewhat more posteriorly placed than in our clinical cases, nevertheless the posterior edge of the upper field of response as given in his paper (Philosoph. Transac., 1898, Vol. 190, p. 54), is almost in exact accord with that determined in our cases of cervical nerve lesion. Here again the anterior boundaries of hypæsthesia found to exist in man would be indeterminable in the animal. In Fig. 24abc, furnished for one of Head's papers, Sherrington has so incorporated his findings as to demonstrate the extent of overlap. It will be seen that the second cervical field practically in its entire extent is doubly innervated. Although our clinical observations cover merely the anterior half of this field they are in accord with the experimental work, however, only in so far as the latter concerns the field of *no response* to any form of stimuli, for the overlap itself is of a different nature and is functionally possessed of a much lower plane of sensativity than had been pre-supposed.

By the "method of remaining æsthesia" Sherrington succeeded also, for the macaque, in demonstrating the presence of the vagus skin-field although for this purpose a very difficult and severe operation was necessitated, namely an intracranial section of the trigeminal root and at the same sitting an intraspinal division of the upper cervical roots on the corresponding side. This was accomplished in two instances, an æsthetic field remaining (Fig. 25) which was considered to represent the vagus (?) distribution to the skin. A similar field, as has been seen, may be determined in man after trigeminal and cervical root division, owing to the functional incompleteness of overlap. The area in the monkey, according to Sherrington, "includes and immediately surrounds the external auditory meatus. It takes in practically the whole of the concha, the antitragus, part of the tragus and part of the antihelix; also part of the fossa of the antihelix." He considers that this field receives in part a quadruple innervation being overlapped not only by the trigeminus but by the second and third cervical segments.

So far as it has been possible to carry out the tests, the observation on the field of anæsthesia over the mucous membranes, after trigeminal neurectomy in the monkey, are in close agreement with the clinical determinations given above. Sherrington notes that the anæsthesia extends fully up to the median line across which an overlap from the opposite side "is very slight or non-existent."

FIG. 24.—Skin-fields of 2nd and 3rd cervical segments and of 5th cranial determined in the macaque according to the method of "remaining æsthesia." Note that overlap between 5th cranial and 3rd cervical is sufficient to completely cover the 2nd cervical. (Sherrington.)

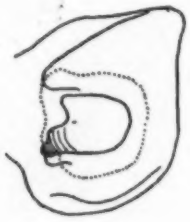

FIG. 25.—Within dotted lines lies the "completely delimited area of auricular of vagus" determined experimentally for the macaque. (Sherrington.)

To summarize the question of overlap between the trigeminal and cervical areas, it may be said: That trigeminal root division in man gives a field of total insensitivity which corresponds with that determinable in the monkey, the complete extent of the skin-field, however, remaining demonstrable, owing to the functional insufficiency of the overlap, delicate tactual anæsthesia persisting over the entire field.

Furthermore, that after division of the cervical branches (roots in one case) the anterior boundary of total insensitivity corresponds approximately with the experimental findings, tactual anæsthesia to delicate stimuli, however, remaining complete (exclusive of the vagus field) almost as far forward as the posterior line delimited in the same way for the trigeminal field. Thus in clinical cases the "method of resulting anæsthesia" serves as well for the establishment of the outline as that of "remaining æsthesia."

4. Embryological Basis for Sensory Distribution.

Without entering into a discussion of the homologies between the cranial and spinal nerves, a subject which has inspired much of the recent work on the development of the lower vertebrates and one which still remains in a somewhat discordant state, the generalization is sufficient for our purposes that the N. trigeminus bears in its structure and in its peripheral and central connections a close parallelism with the double system of ventral and dorsal roots of the spinal segments and it is possible to establish for this nerve and for those cranial ones which follow a certain metameric disposition similar to that characterizing the spinal nerves.

So long as it represents the only pathway for all the splanchnic and somatic afferent fibers from that portion of the head which has developed anterior to the first visceral

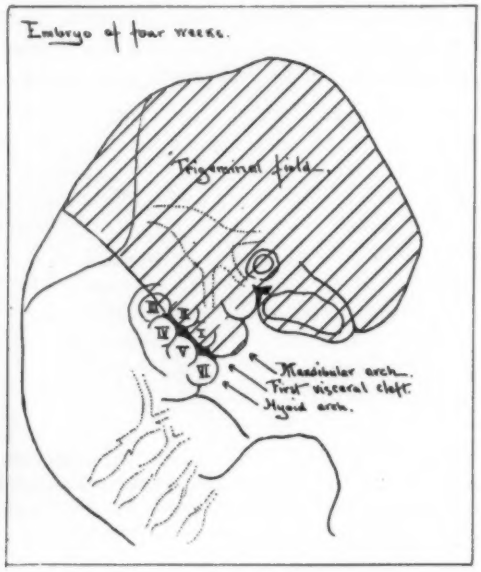

Fig. 26.

cleft, it is immaterial for our purposes whether or not the Gasserion ganglion represents the fusion of one or more cranial dorsal root ganglia.

In the early embryo (Fig. 26) this deep cleft serves to divide the mandibular bar, which is innervated by the N. mandibularis division of the trigeminus, from the posteriorly placed hyoid arch whose main nerve is the N. facialis. Around the dorsal end of the cleft lie grouped the six cartilaginous tubercles (Fig. 26) which according to the investigation of Wm. His, Jr., represent the rudiments of the external ear. Two of them according to his description lie on the mandibular side of the cleft and develop, one, into the tragus, the other into a portion of the helix (its crus according to Schwalbe). The third protuberance (tuberculum intermedium) His places at the upper end of the cleft possibly developing from its mandibular, possibly from its hyoidal side; it is destined to form the anterior ascending portion of the helix. The fourth, fifth and sixth tubercles develop from the hyoidal arch and are the rudiments respectively of the antihelix, the antitragus and the lobe of the ear. Schwalbe[10] and Gradenigo have a somewhat different adult destination for these hyoid tubercles, though the general plan is much like that of His. Of the helix itself only a portion of its ascending limb arises from the mandibular arch whereas the major part is hyoidal in origin. Had the writer been sufficiently familiar with the plan of development of the ear before the clinical observations were made, the configuration of the auricular portion of the field might have been anticipated; the sensory nerves reach the skin field before the disappearance of the cleft and naturally enough the tragus, the crus of the helix, and at times a part of its ascending portion, together with the anterior wall of the external auditory canal, retain a trigeminal innervation. In the

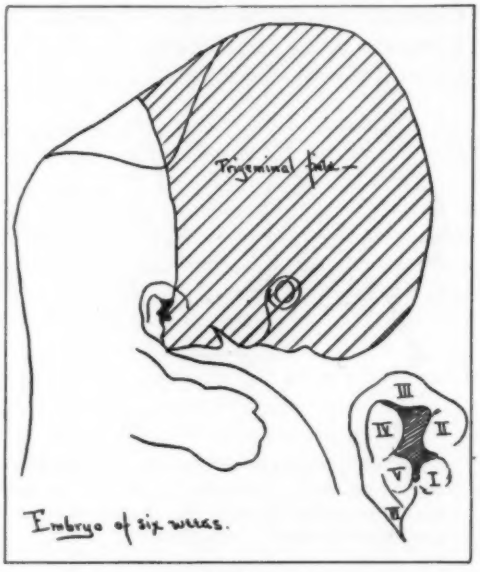

Fig. 27.

accompanying series of figures (Figs. 26-30) an effort had been made to schematize the development of this fifth cranial skin-field and to show the effect upon its configuration of the auditory point of anchorage, for here it remains fixed while the growth of the lower jaw and occiput crowd, as it were, the underlying structures out from under their original cranial trigeminal skin covering. It is quite possible that the third or even the fourth auricular tubercle may in certain cases have originally been of mandibular origin thus a portion of the antihelix, together with its fossa would naturally be innervated in the adult by the trigeminus. The subvarieties of auricular distribution which have been described might thus be accounted for.

In similar wise may we account on morphological grounds for the distribution to the mucous-membrane field of the adult. The tongue develops from a tubercule (the tuber-

[10] "Das äussere Ohr." Bardeleben's Handbuch der Anatomie des Menschen, 1897, Bd. 5, Zweite Abteilung, p. 129.

culum impar of His) arising from the mid-line of the floor of the pharyngeal wall at the junction of the lateral mandibular bars or between these and the hyoid arches and so receive chiefly a fifth cranial nerve supply. Its posterior portion however arises from a fusion of the bases of the second and third arches and for some time these anterior and posterior sections of the tongue are separated by a deep V-shaped cleft which runs closely parallel with the line of circumvallate papillae; these papillæ, however, develop from the anterior or mandibular portion, lie a few mm. in front of the line of division and should remain innervated by the trigeminus. This I have not succeeded in demonstrating, for the area is difficult of access.

The palate possesses another border area, the configuration of which is explicable by developmental conditions. Arising from the maxillary process by two shelf-like growths which meet and unite in the mid line, thus closing off the nasal from the oral cavities, the palate in large part naturally has a fifth nerve supply. The shelves, however, according to Minot, extend back across the second and third branchial arches and thus the palatal attachments in their lower and posterior position receive, as would be expected, a nerve supply other than from the fifth cranial. The tonsil also which has developed from an anlage in the second visceral cleft, receives a glosso-pharyngeous supply.

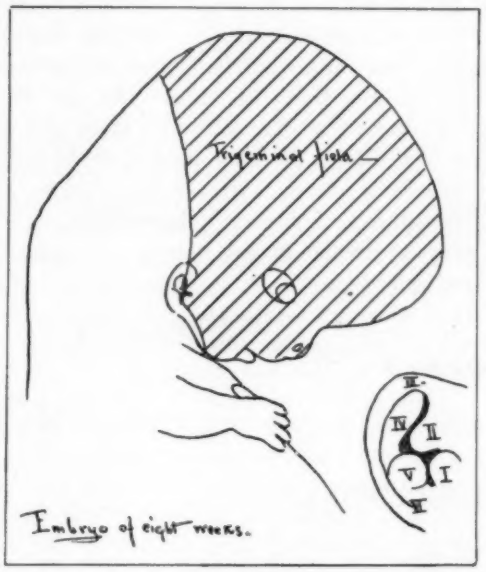

FIG. 28.

Although the matter has not been completely worked out, it may be said in general that there is a particular cranial nerve originally destined in large part for each of the branchial arches, and that, as each of these nerves approaches the dorsal end of the cleft, it divides sending its main branch to the arch of destination and a smaller anterior (præ-trematic) branch to the arch lying anterior to it. Thus, the N. facialis, the particular nerve for the second or hyoid arch, sends forward a branch into the mandibular arch; the N. glossopharyngeus, the nerve of the third arch, sends forward a branch into the second and so on. The facial nerve, however, although generally accredited by morphologists as having the characteristics of a mixed nerve, is not commonly believed to possess a sensory function. It is quite likely, however, that splanchnic afferent fibers pass to the facial by way of the large superficial petrosal and I have been inclined, also, from the clinical evidence cited above, to ascribe to this nerve not only the taste fibers, but also fibers conveying the peculiar form of sentiency which remains in the tongue (its tuberculum impar portion) after a trigeminal neurectomy. One would expect also, did the facial in man have afferent fibers, that the cutaneous field of the adult which has originated

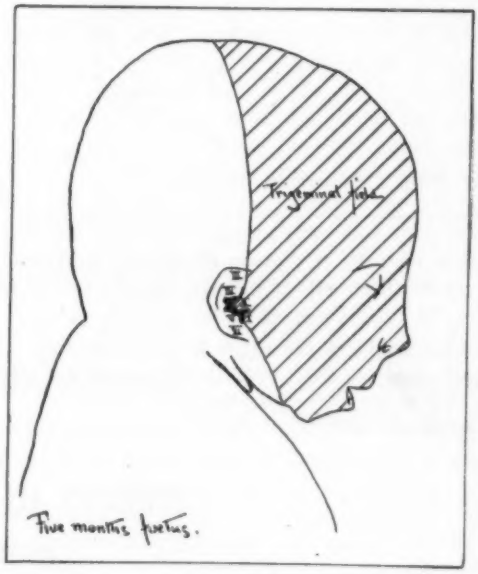

FIG. 29.

from the covering of the hyoid arch would be likewise innervated by this nerve so that the portion of the ear developing from the hyoid tubercles would have a facial supply. It is perhaps worthy of note in this connection that Arnold's nerve from the vagus supposedly destined for the auricular skin-field, commented upon above, has invariably a large anastomosis with the facial as it crosses the lower end of the Fallopian canal. Whether there may not be some afferent fibers consequently from the seventh in this peculiar aberrant nerve is worthy of investigation. It occasionally passes entirely into the facial trunk.

The third arch is supplied by the glosso-pharyngeus, the anterior (præ-trematic) branch of which penetrates into the field of the hyoid arch and gives off the Nervus tympanicus, through which afferent fibers supply the mucous-membrane field adjoining the trigeminal area, namely the middle ear, part of the Eustachian tube and pharyngeal wall. Afferent

fibers from the skin (somatic) are apparently entirely wanting for this nerve. Its post-trematic branch is the Ramus lingualis.

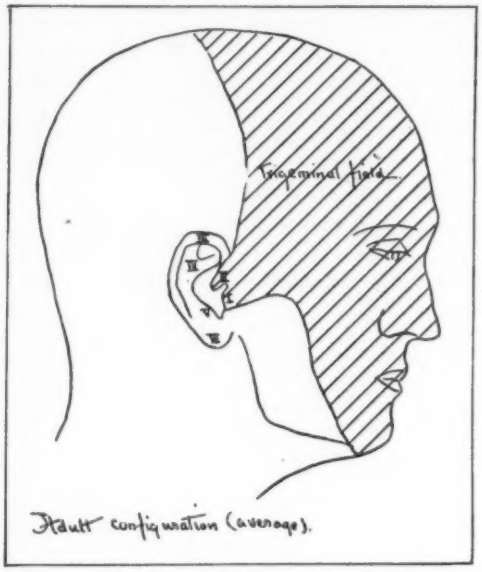

FIG. 30.

FIGS. 26–30.—A series of diagrams schematizing the gradual distortion of the trigeminal skin-field during development into the adult form.

The relationship of the vagus to the succeeding arches is much more complex and less well understood. Its splanchnic field possibly may adjoin the trigeminal mucous membrane field, though one would suppose the fields of the facial or glosso-pharyngeal would completely intervene. Intracranially it is supposed to adjoin the trigeminal field for the dura, since it supplies this membrane in the neighborhood of the foramen magnum. There is no satisfactory explanation for its peculiar cutaneous branch to the external ear, though it may be a rudimentary expression of a large somatic branch found in fishes. The fate of the visceral arches, which disappear in the course of the fifth week, has been discussed by Wm. His in an article on "Die Retromandibularbucht"[19] and in such a way as make easily intelligible the adult disposition of the structures originally pertaining to each of them.

With the exception of the small auricular field of the vagus (?) the next adjoining nerves to the fifth cranial which possess, or at least which retain until adult life, afferent fibers from the skin arise from the cervical cord and hence the question of cutaneous overlap is involved alone with the consideration of this field; the lower cranials on the other hand possess splanchnic afferent fibers so that overlap from the mucous-membrane field necessarily brings into consideration the intervening cranial nerves, namely, the facial, glosso-pharyngeal and vagus.

[19] Anatomischer Anzeiger, 1886, Bd. I, p. 22.

STEPHEN HALES, THE PHYSIOLOGIST.[1]

BY PERCY M. DAWSON, M. D.,

Associate Professor of Physiology, Johns Hopkins University.

A few weeks ago we saw that Stephen Hales was to be regarded not only as a clergyman but also as a philanthropist and a scientist. At that time it was stated that his "contributions to animal physiology were many and important" but that "a discussion of this part of Hales' work would be reserved for another communication."

The account of Hales' work on this subject is contained in the Statical Essays: in the chapter of Vol. I describing the experiments "which show in how great proportion Air is wrought into the composition of animal, vegetable and mineral substances," but chiefly in that part of Vol. II which is entitled "Haemostaticks."

In presenting this subject no attempt has been made to give even a sketch of the whole field of physiology as it appeared to Hales or was affected by his researches. The purpose of the writer being to give some insight into the character rather than into the scope of the work, he has selected certain passages from the "Haemostaticks" and has merely supplemented these quotations with such explanations and comments as have seemed to him needful or appropriate.

"What I had first intended[2] only as additional Observations and Experiments to the first Volume, is now grown to the Size of another Volume, so fruitful are the Works of the great Author of nature in rewarding, by farther Discoveries, the Researches of those *who have pleasure therein:* We can never indeed want for Matter for new Experiments; and tho' the History of Nature as recorded by almost innumerable Experiments, which have been made within the compass of a Century, be very large, yet the Properties of Bodies are so

[1] Read before the Johns Hopkins Hospital Historical Club, May 11, 1903.

[2] Preface: Hæmostaticks, 1733.

various, and the different Ways by which they may be examined so infinite, that 'tis no wonder that we as yet have got little farther than the Surface of Things: Yet ought we not to be discouraged, for tho' we can never hope to attain to the compleat Knowledge of the Texture, or constituent Frame and Nature of Bodies, yet may we reasonably expect by this Method of Experiments, to make farther and farther Advances abundantly sufficient to reward our Pains.

"And tho' the Method be tedious, yet our Abilities can proceed no faster; for as the learned author of the *Procedure of human Understanding* observes, pag. 205, 206, 'All the real true Knowledge we have is entirely *experimental*, in so much that, how strange soever the Assertion seems, we may lay it down as the first fundamental and unerring Rule of Physicks, *That it is not within the compass of human Understanding to assign a purely speculative Reason for any one Phenomenon in Nature.*'"

"As the animal Body[3] consists not only of a wonderful texture of solid Parts, but also of a large proportion of Fluids, which are continually circulating and flowing, thro' an inimitable Embroidery of Blood-Vessels, and other inconceivably minute Canals: And as the healthy State of the Animal principally consists, in the maintaining of a due *Equilibrium* between those Solids and Fluids; it has, ever since the important Discovery of the Circulation of the Blood, been looked upon as a Matter well worth the inquiring into, to find the Force and Velocity with which these Fluids are impelled; as a likely means to give a considerable Insight into the animal OEconomy."

"Several ingenious Persons have from time to time, attempted to make Estimates of the Force of the Blood in the Heart and Arteries, who have as widely differed from each other as they have from the Truth, for want of a sufficient Number of *Data* to argue from: Had Persons of their Abilities been more careful, in the first Place to get what Insight they could into the Matter, as far as a regular Series of proper Experiments would have informed them, they would then doubtless have been furnished with more and more proper *Data* whereon to found their Calculations, which would have brought them much nearer to the Truth."

"It may not be improper[4] here to take notice, that being about twenty-seven years since, reading the unsatisfactory conjectures of several, about the cause of muscular motion, it occurred to me, that by fixing tubes to the arteries of live animals, I might find pretty nearly, whether the blood, by its mere hydraulic energy, could have a sufficient force, by dilating the fibres of the acting muscles, and thereby shortening their lengths, to produce the great effects of muscular motion. And hence it was, as I mentioned in the preface to Vol. I, that I was insensibly led on from time to time into this large field of statical and other experiments." How this hydraulic energy was measured is described in the following classical experiments which have given us the Hales manometer.

"In December[5] I caused a *mare* to be tied down alive on her back; she was 14 hands high, and about 14 years of age; had a fistula on her withers, was neither very lean nor yet lusty: having laid open the left crural artery about 3 inches from her belly, I inserted into it a brass pipe whose bore was $\frac{1}{6}$ of an inch in diameter; and to that, by means of another brass pipe which was fitly adapted to it, I fixed a glass tube, of nearly the same diameter, which was 9 feet in length: then untying the ligature on the artery, the blood rose in the tube 8 feet 3 inches perpendicular above the level of the left ventricle of the heart: . . . when it was at its full height, it would rise and fall at and after each pulse 2, 3, or 4 inches; . . . ."

"Then[6] I took away the glass tube, and let the blood from the artery mount up in the open air, when the greatest height of it's jet was not above 2 feet."

"I measured[7] the blood as it run out of the artery, and after each quart was run out, I refixed the glass tube to the artery to see how much the force of the blood was abated; this I repeated to the 8th quart, and then its force being much abated, I applied the glass tube after each pint had flowed out: . . . ."

This experiment was repeated on two other horses and the relation of the blood pressure to the amount of the blood removed was shown in a series of tables. The technique employed by Hales in these experiments is not without interest: "In December[8] I laid a common field gate on the ground, with some straw upon it, on which a white *mare* was cast on her right side, and in that posture bound fast to the gate: . . ." It was of course difficult to keep the manometer in place when the animal struggled and as there was no rubber tubing in those days with which a flexible joint could be made for the pieces of "brass pipe" some other method had to be devised. Accordingly we read that in one of these experiments Hales joined the brass pipe to the glass tube by means of the windpipe of a goose.[9]

A necropsy on one of the horses showed that "There" might be about two quarts and three-quarters of blood left in the large veins, which, with what was drawn out at the artery, makes five wine gallons, which at 221 cubick inches to the gallon, amounts to 1105 cubick inches, or 42.2 pounds; which, at a low estimation, may be reckoned the quantity of current blood in the horse; there is, doubtless, considerably more, but it is not easy to determine how much." When these calculations are expressed in modern terms we find that, according to Hales, the total amount of blood in the horse is "doubtless considerably more" than 4.6 to 5.2 per cent. of the body weight while the lethal hemorrhage is about 2.7 per cent. of the body weight.

[3] Introduction. 1. Hæmostaticks, 1733.

[4] Exp. IX, 23. Hæmostaticks. Where, as in this case, the year of publication is not given it is to be understood that the edition of 1769 is meant. This second edition differs but little from the first except in the less frequent use of capitals.

[5] Exp. I, 1.

[6] Exp. I, 3.

[7] Exp. I, 4.

[8] Exp. III, 1.

[9] Exp. III, 6.

[10] Exp. I, 13.

In one of these horses the pressure in the jugular vein was determined. When the animal was quiet this amounted to only 12 inches but this rose to 52 inches when the animal struggled."[11]

Experiments similar to the above were performed upon other animals namely, a sheep, a doe and twenty dogs, for, says he, "whatever experiment I principally intended to make on any dog, I usually began with fixing a tube first to the jugular vein and then to the carotid artery."[12]

Hales then filled a number of hearts with melted beeswax,[13] then cutting away the tissue, he measured the volume and the superficial area of the casts. With these two factors and knowing the blood pressure, the heart rate, the diameter of the aortic orifice and of the aorta itself, he calculated for horses, oxen, deer, sheep, dogs and man, the mean velocity of the blood in the aorta, the velocity of the systolic output and the total amount of pressure sustained by the heart at the beginning of each contraction. Into all these calculations the capacity or volume of the heart entered as a factor; a factor which, as has been said, Hales determined by the use of melted wax. Now as a matter of fact, the volume of the heart cannot be determined in this or in any other way with any degree of accuracy so that all his calculations are more or less incorrect. But in spite of these inaccuracies we see that Hales had advanced one step beyond Harvey, in that the results of the latter are qualitative whereas those of Hales are quantitative.

That Hales possessed a clear conception of the nature of the blood pressure and of the factors upon which it depends, is readily seen from the following passage. After discussing the rate of the output of the heart he continues: "Now this velocity" is only the velocity of the blood at its first entering into the *aorta,* in the time of the *systole;* in consequence of which the blood in the arteries, being forcibly propelled, with an accelerated *impetus,* thereby dilates the canal of the arteries, which begin again to contract at the instant the *systole* ceases: by which curious artifice of nature the blood is carried on to the finer capillaries, with an almost even tenor of velocity, in the same manner as the spouting water of some fire engines is contrived to flow with a more even velocity, notwithstanding the alternate *systoles* and *diastoles* of the rising and falling *embolus* or force . . . ." And again, "For tho' the velocity" of the blood at its first entrance into the *aorta,* depends on the proportion the area of its orifice bears to the quantity thrown into it at each *systole,* and also on the number of these *systoles* in a given time: yet the real force of the blood in the arteries, depends on the proportion, which the quantity of the blood thrown out of the left ventricle in a given time, bears to the quantity which can pass thro' the capillary arteries into the veins in that time."

"The force of the blood"[14] in the veins and arteries is very different, not only in animals of different species but also in animals of the same kind; and that not only in those of different sizes and weights, but also in dogs of the same size and weight; and even in the same animal the force of the blood in its vessels is continually varying, according to the different kinds and quantities of food, the various distances of the time after taking food, the more or less plethoric state of the blood vessels, also from exercise, rest, different states of vigor or vivacity of the animal, and many other circumstances, which may conduce to vary the force of the blood: for the healthy state of animals is not confined to the scanty limit of one determinate degree of vital vigor in the blood: but the all-wise Framer of these admirable machines has so ordered it, as that their healthy state shall not be disturbed by every little variation in this force, but has made it consistent with a very considerable latitude in the variation of it . . . ."

Hales fully appreciated the difference between lateral and end pressures, for, referring to the fact that the brass pipe was inserted directly into the carotid or crural artery, he remarks, "It may be objected" to this method of estimating the force of the blood that by thus fixing tubes in these large veins and arteries, the source of a considerable stream of blood was for the time stopped; and that consequently the force of the blood must be proportionally increased in the veins and arteries." In order to obtain lateral pressures Hales adopted the following ingenious device. He placed the blood vessel between two grooved pieces of wood which were then cemented together and to the vessel by means of warm pitch. One of these pieces of wood had had a hole bored in it. Through this he punctured the vessel and screwing a tube into the hole, he allowed the blood to mount up into it.

That Hales understood the relation of the velocity of the blood to the area of the stream bed; that, in other words, he applied Leonardo da Vinci's law to the circulation is seen in the following. "The arteries" continually sending off innumerable branches, the sum of whose orifices is considerably larger than the main stems, hence the velocity of the blood must be proportionately rebated." Nor did he fail to allow for the effect of hydrostatic pressure, for he writes, "when the animal" stands on its legs, a column equal to the perpendicular height of the animal, must be added to the several heights of the blood in the glass tubes, in order to estimate the force with which the blood presses against the coats of the blood vessels, at the lower parts of the body, and so in proportion for any other part that is higher."

In the following series of experiments Hales endeavoured to show that the greatest resistance offered to the blood flow is that which occurs in the capillary area.[17] He slit the gut of a freshly killed dog along its greater curvature and running in by way of the aorta "blood-warm" water under a column of pressure (4½ feet) equal to the pressure exerted by the heart, he found that the fluid only oozed out. It required in fact six minutes for 300 cubic inches of the liquid to pass through the gut. He then cut away the guts along the line of

[11] Exp. III, 2-4, also table on p. 42.
[12] Exp. VII, 1.
[13] Exp. III, 11 &c.
[14] Exp. VII, 2.
[15] Exp. III, 26.
[16] Exp. IX, 13.
[17] Exp. VII, 5.
[18] Exp. VIII, 23.
[19] Exp. VII, 8.
[20] Exp. IX.

their mesenteric attachment and found that the time now required was only two minutes, while on cutting the vessels close to the aorta, the time was still farther reduced to 0.3 minutes or only 0.05 of the time which had originally been required for the same quantity of liquid to pass through the slit gut.

The vessels of the slit gut then offer considerable resistance to the flow of blood, but the resistance offered by the gut in the intact animal must be far greater for the following reasons.[21] If 300 cubic inches of blood passed through the intact gut in six minutes, then it may be shown that at each systole one-half of the blood in the heart must pass to the gut. If now we compare the weight of the gut with that of the other blood-containing tissues, we see that the intestine should receive only 1-26 of the heart's output at each systole. In other words the intestine in the living animal offers thirteen times as much resistance to the passage of blood as in the experiment above described. The reasons for this great difference are:[22]

(1) The greater fluidity of water as compared with blood.

(2) The absence of the back pressure of the veins in the one case and its presence in the other.

(3) The greater distensibility of the dead arteries.

(4) In the case of the slit gut the fluid is no longer obliged to pass through the fine capillaries but runs out through the larger vessels which have been severed.

It will be remembered that the origin of these hydraulic and hydrostatical experiments was the desire to know if the blood possessed force enough to bring about the phenomenon of muscular contraction. By subtracting from the pressure in the smaller arteries the pressure in the corresponding veins, Hales obtained a figure which represented the loss of force sustained by the blood in passing through the capillaries. Though the sum total of this force was of course considerable, he found that the amount lost at any one point was entirely inadequate to account for muscular action.[23] Hence he thought that it was to the animal spirits that we must look for an explanation. Not satisfied like so many of his contemporaries with invoking the aid of these hypothetical spirits, and then considering the question solved, Hales suggests that animal spirits may be in some way related to electricity.[24] He therefore tried to demonstrate electrical properties in blood. In this, however, he failed.[25]

One of the most interesting series of experiments undertaken by Hales was that pertaining to the effects of various substances and of water at various temperatures on the calibre of the arterioles or as he calls them "capillary arteries." "I took a young spaniel dog,[26] . . . opened his *thorax* and *abdomen*, and having fixed a glass tube, which was $4 + \frac{1}{2}$ feet high, to the descending aorta, I then slit open his guts, from end to end . . . . Then having poured blood-warm water on them, and covered them with a folded cloth dipped in the same water, warm water was poured into the tunnel [attached to the tube]; which when it had subsided to a mark on the lower part of the glass tunnel, 18 cubick inches of warm water were immediately poured in, out of a pot which held just that quantity: the time that it was running thro' the fine capillary arteries was measured by a pendulum that beat seconds."

"I first poured in seven pots full of warm water, the first of which passed off in 52 seconds, and the remaining six gradually in less time to the last, which passed in 46 seconds."

"I then poured in five pots of common brandy, or unrectified spirit of malt, the first of which was 68″ in passing, the last 72″."

"I then poured in a pot of warm water which was 54″ in passing."

"Hence we see that brandy contracts the fine capillary arteries of the guts, and that water soon relaxes them again, ..."[27]

A decoction of Peruvian bark[28] contracted the vessels. A decoction of "Chamomel flowers"[29] caused some constriction but not so much as cinnamon-water with which the constriction is very marked indeed. Pyrmont water[30] was also very effective.

Hales considered these experiments to be of importance as indicating the probable action of these substances in the living body "tho' it is not to be imagined,[31] that the effects are so sudden and great in a live animal, as in these experiments; because in a live animal, the several fluids which are taken in, are more gradually and in smaller proportion blended with the blood." "'Tis probable,[32] that such things as constringe the vessels in any degree, do also proportionately increase the force of the arterial blood, and thereby invigorate the animal. But those who much accustom themselves to drink strong spirituous liquors, do thereby destroy the tone of the fibres of their vessels, by having them thus frequently, suddenly contracted, and so soon relaxed again; which makes them like the horse-leech, be ever longing after and thirsting for more and more, thereby to regain again the tensity of their too relaxed fibres.

"After having seen[33] many proofs of the great force of the blood in the arteries, and also in the veins, when an animal exerts its strength; I thought it might not be a useless inquiry to examine the strength of the coats of those vessels."

"I poured[34] into an inverted glass syphon some mercury, so as to have the shortest leg, which was hermetically sealed, filled within four inches of the top; to the other open end of the syphon I fixed, by means of a brass pipe, one end of the right carotid artery of a small spaniel dog, and to the other end of the artery was fixed a condensing syringe. Then

[21] Exp. IX, 6.
[22] Exp. IX, 7.
[23] Exp. IX, 16.
[24] Exp. IX, 18-19.
[25] Exp. XIII.
[26] Exp. XV, 3-7.
[27] Hales also compared the effect obtained with warm water and with cold pump water. The former flowed readily through the gut requiring only 18 seconds for the passage, while the latter caused a marked constriction and took 80 seconds to pass through the gut.
[28] Exp. XVI.
[29] Exp. XVII.
[30] Exp. XVIII.
[31] Exp. XVIII, 4.
[32] Exp. XVIII, 5.
[33] Exp. XXII, 1.
[34] Exp. XXII, 2.

placing the artery in water to see whether it leaked, I impelled the air in to such a degree as made the mercury compress the air between it and the sealed top of the tube into so small a compass, as showed by estimation, the force to be equal to a column of water 190 feet high, or equal to the weight of 5.421 atmospheres; with this force the artery burst at once, but no air passed thro' its coats before it burst."

Experiments similar to the above were repeated on the arteries and veins of various animals. Hales then estimated the normal variations in the blood pressure in both arteries and veins and observed the wide margin which exists between the maximum pressure of the blood and the breaking point of the vascular walls. These results seem to have impressed him very much for he wrote "We see[85] in these instances the great strength of the coats of these vessels; what great reason have we therefore with thankful hearts to say to our Creator, as holy Job did, when he contemplated on the wonderful frame and strength of his body, Job X. 2., *Thou hast* not only *fenced me with bones and sinews,* but hast also effectually secured the vital fluid in such strongly wrought channels, as are proof against its most lively and vigorous sallies, when either agitated by the different passions, or by strong and brisk actions of the body!"

Surprised by the results of his experiments on the strength of the arteries and veins, Hales proceeded to try similar experiments on other tissues. "I took[86] the instep bone of the hinder leg of a calf" fastened one end by a cord to the threshold of a door case, then with an iron bar as a lever attached to the other end pulled the bone apart at the epiphysis. "I found the tenacity and resistance of this joining to be equal to 119 lbs., when the periosteum was removed." It required 550 lbs. to pull apart the bone of the other leg in which the periosteum had not been removed. Subtracting 119 from 550, we get 431 which is then the strength of the periosteum.

"As a force[87] equal to five hundred and fifty pounds was found requisite to separate the above-mentioned joining *symphysis,* so in the growth of the bone lengthwise at that joining nature must exert a like power; not that we are to suppose that the growing fibres are forcibly stretched out at each end, ... But yet the whole sum of the power must be superior to the resistance of all the fibres which connect this juncture."

"I made[88] hydraulic and hydrostatical Experiments not only on the arteries and veins, but also on the intestinal tubes; by affixing, in like manner, tubes of different heights to each end of them, while they were warm.

"I fixed[89] a tube to the gullet of a dog and then poured in water, till the stomach was so full, that the water in the tube stood 36 inches perpendicular height above the stomach; which force burst it lengthwise in its upper part near the pilorus, where it was but $7 + \frac{1}{2}$ inches of circumference: yet no water was impelled through the *pilorus* with this force, though in some other like experiments it has run thro' there into the guts. Another dog's stomach burst in the larger left part of it, when the height of the column of water was but 30 inches."

"On measuring[90] the distention of the stomach in another dog, I found its whole surface equal to 80 square inches, which multiplied into 36, the height of the water in the tube, gives 2880 cubick inches of water, or 104 pounds weight of water, which pressed against the sides of the stomach: and allowing the area of the greatest transverse section of the stomach to be equal to 30 square inches, then the pressure of the water against the fibres of the stomach in that section, when it burst, will be 39 pounds. Which shows how greatly Borelli and Pitcairn were mistaken, when they estimated the force of the fibres of the stomach to be equal to 12,951 pounds; since we may with good reason conclude that the force of those fibres cannot in the live animal be greater than the force which will tear them asunder, as soon as dead. Neither can the pressure of the *diaphragm* and of the muscles of the abdomen on the stomach, be in our utmost straining greater than a weight of mercury two inches deep, and of the breadth of all their areas, as I have shown under Experiment CXVI, Vol. I, p. 270. And that the sum of the compressure of the muscles of the *abdomen* and *diaphragm,* and so also of the stomach on its contents, is not nearly equal to the weight of two inches deep of mercury, is evident from the Appendix,[91] Exper. VII of this Vol. II, where it was found by a mercurial gage fixed in the nose of large pair of smith's bellows, that the most forcible blast of them will scarcely raise mercury two inches high in the gage: And since such a blast of wind is manifestly much greater than the most forcible puff of wind, which is belched out of a distended stomach; it is hence evident, that the stomach, even in that much distended case, does not compress what is contained in it with near that force."

"If we suppose[92] the surface of a full stomach to be equal to 80 square inches, and that its contents are compressed by the action of it, together with that of the *diaphragm,* and the muscles of the *abdomen,* with a force equal to one inch in depth, then the whole pressure on its contents will be equal to 39 pounds, which is nearly the weight of 80 cubick inches of mercury: but as this seems to be too great a force by comparing the velocity with which wind rushes out of bellows, which force is sufficient to raise mercury an inch in the gauge; so I believe half that force, *viz.,* about 20 pounds, would come nearer to the pressure of the aliments in a full stomach."

"Now[93] so small a compressure can have very little effect in promoting the digestion of the aliments: which is therefore with good reason principally attributed to the concurrence of several other causes; such as mastication and com-

[85] Exp. XXII, 12.
[86] Exp. XXII, 29.
[87] Exp. XXII, 33.
[88] Exp. XXIII, 1.
[89] Exp. XXIII, 2.
[90] Exp. XXIII, 3.
[91] "Appendix containing Observations and Experiments relating to several Subjects in the First Volume."
[92] Exp. XXIII, 4.
[93] Exp. XXIII, 5.

minution with the teeth, and mixture first with *saliva* (which is a leaven full of elastic air), and afterwards with the fluid, which is in plenty separated from the glands of the stomach; . . . . "

Regarding the function of the lungs [a] Hales was somewhat in doubt, but foremost he placed their refrigerating action. One is accustomed to see this function of the lungs discussed by the older writers in a more or less hazy and indefinite way. Hales, however, carefully calculates, or rather has calculated for him, the exact amount of this refrigeration. Having determined the quantity of blood passing through the lungs per minute, the amount of air breathed during the same time, and finally the difference in the temperature of the inspired and the expired air, he communicated these data to Dr. Desaguliers and Mr. Ch. de Labely. These gentlemen then showed that as much heat is lost in two minutes by way of the lungs as would be required to raise all the blood in the body 0.101928 of a degree, or conversely if one holds his breath for two minutes, "as Gano the trumpeter can," the temperature of his blood will rise 0.101928 of a degree in that time.

When shaken, blood becomes florid, it also becomes florid in passing through the lungs, hence it may be, Hales suggests, that the blood is shaken by the movements of the lungs, but why that should be of any value he was unable to state. He concludes his discussion of the functions of the lungs with the following paragraph: "It is probable [b] also, that the blood may in the lungs receive some other important influences from the air, which is in such great quantities inspired into them. It has long been the subject of inquiry of many, to find of what use it is in respiration, which tho' it may in some respects be known, yet it must be confessed that we are still much in the dark about it."

The "Hæmostatics" is without form or order; in this treatise Hales simply rambles on and on, each experiment suggesting another, so that he was led almost imperceptibly to study a great many physiological phenomena.

The above extracts and abstracts have been given in the hope of imparting some idea of the experimental methods employed by Hales and of the character of the reasoning to which he resorted in his study of animal physiology. The "Haemostaticks," however, contains much more than this. On the title page of Volume II of the Statical Essays stands a quotation from the Instauratio Magna: "True and living natural philosophy upon which the science of medicine is built is a thing to be desired." Having laid a foundation Hales began to build, to apply his physiological lore to medical problems. Hence the "Essays" abound in practical suggestions, some of which are excellent, and in theoretical explanations, most of which are worthless. But one must not criticise him too severely. No one appreciated better than he the proper function of speculation as is shown again and again in his writings. "In natural Philosophy, we cannot depend on any meer Speculations of the Mind; we can only with the Mathematicians, reason with any tolerable Certainty from proper *Data*, such as arise from the united Testimony of many good and credible Experiments."

"Yet" it seems not unreasonable on the other hand, tho' not far to indulge, yet to carry our Reasonings a little farther than the plain Evidence of Experiments will warrant; since at the utmost boundaries of those Things which we clearly know, there is a kind of Twilight cast from what we know, on the adjoining Borders of *Terra incognita*, it seems therefore reasonable in some degree to indulge Conjecture there; otherwise we should make very slow Advances in future Discoveries, either by Experiments or Reasoning: For new Experiments and Discoveries do usually owe their first Rise only to lucky Guesses and probable Conjectures, and even Disappointment in these Conjectures, do often lead to the Thing sought for: Thus by observing the Errors and Defects of a first Experiment in any Researches, we are sometimes carried on to such fundamental Experiments, as lead to a large Series of many other useful Experiments and important Discoveries."

The debt which medicine owes to physiology is not so much for its facts as for its methods; and although it was left for another [c] to introduce the method of experiment into medicine, still in the evolution of this method Hales played an important rôle. It is, therefore, because his researches are among the earliest examples of *quantitative* work in the field of animal physiology that they merit our attention and indeed our admiration.

[a] Exp. XIII, 14. [b] Exp. XIII, 36. [c] Introduction: Hæmostaticks, 1733. [d] François Magendie.

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SERIES I-II-III.

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THE CHEMICAL ORIGIN OF LEUCOCYTES.

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Fellow by Courtesy, Johns Hopkins University.

(*From the Clinical Laboratory of the Johns Hopkins University.*)

The Chemical Origin of Cell Nuclei.

In the following experiments I have tried to answer the question whether the organism is able to synthesize the nuclein of its tissue cells, or is obliged to build them out of the cell material contained in its food.

This problem can best be solved by putting a man on a nuclein-free diet. Then, if he is unable to synthesize nuclein for himself, the constant consumption of a certain proportion of the cell constituents would lead to a general diminution in the cells of the body. But it is highly probable that the consumption of the tissue cells and their new formation is a very limited one, a view borne out as well by histological observations as by experiments in metabolism. Hence, it seems to be quite impossible to settle this question by observations on the normal man, and recourse must be had to an organism in which the cell destruction is pathologically increased. The best illustration of increased cell formation and increased cell destruction is seen in leukæmia, in which disease the leucocytes are rapidly destroyed and as rapidly rebuilt. For this reason I have chosen this disease as the subject of my studies. Before I begin a detailed description of my results I should like to give a brief résumé of our present knowledge of the chemical composition of the cell nuclei and their origin.

The proteids of our food and of our body may be divided into three classes—albumin, paranuclein or phosphoglobulin and true nucleins. Albumin forms the chief constituent of protoplasm and is perfectly phosphorus-free. The paranucleins are the secretory products of the same glandular organs; these contain phosphorus and constitute the building material of the growing organism. The two best-known representatives of this group are the casein of the milk and the vitellin of the yolk of the egg. The third group, the nucleins, form the chief constituent of the cell nuclei. They contain phosphorus and show the characteristic atom-complex of nucleic acid, which combined with albumin, constitutes these bodies. Since albumin is abundantly present in all foods, our question resolves itself to the simple form, is the human organism able to form synthetically nucleic acid?

The first example of new formation of nuclein material in this manner was given by Miescher (1) in his too little known work on the life of the Rhine salmon. He was able to demonstrate that the ovary and the testicle, both exceedingly rich cellular organs, are built at the expense of the lateral muscles, one of the tissues poorest in cells, and that the phosphorus necessary for the structure of the cell nuclei is transported in the form of lecithin. The second illustration of such anabolism was given by Kossel (2) and Tichomiroff (3). They were able to prove that eggs did not contain any nuclein bases before incubation, but showed during their extrauterine development a large amount of nuclein bases corresponding to the new formation of cells. Analogously the growing organism, as it was demonstrated by the work of Burian and Schur (4), builds its supply of nuclein and purin bases from milk, which is practically purin-free. The amount of those purin bodies formed was estimated by them by comparing the amount of nucleins in dogs at birth and after they had lived for some time on milk.

These three facts prove that the organism is able to build nuclein from nuclein-free food, and to synthesize its needed cell material in the case of the growing organism; but not whether the adult body is able to perform this synthesis, or has to draw upon its supply in the food for the building of its cell material. To judge the nuclein metabolism in the body and to get a sufficiently clear picture of the changes in the tissues, we have to see if there is any product in the urine which takes its origin exclusively in the nucleins and would allow us to estimate by the amount of its output the breaking down of the cells in the organism. These means are given by the excretion of uric acid. To show the relation between cell material and uric acid output, we must refer to the formation of this body.

Since the investigations of Horbacsewsky (5) and Weinbrand (6) we know that the purin bases contained in the nucleins of the food or of the body have a special influence on the formation of uric acid. They showed that an increased destruction of nucleins occasioned either by an increased breaking down of cell nuclei or by a higher amount of nucleins ingested in food leads to an increased formation of uric acid. That uric acid is a specific oxidation product of nuclein bases was then proven by Hess and Schmoll (7), who were able to show that food influenced the uric acid excretion only when it contained purin bases. Any amount of albuminous substances could be ingested without influence upon the uric acid output so long as these bodies did not contain any purin bases; on the other side, every food which contained purin bodies increased the uric acid output. Those experiments show that the uric acid excretion is caused only by oxidation of purin bases; but they show at the same time that no nuclein synthesis can be proven, and if any takes place the amount built up can only be so small that it does

not appear by our methods of metabolism investigation. Then, if on the one hand the uric acid can only be influenced by the oxidation of the purin bases, on the other hand the excretion of the uric acid gives us means to estimate the breaking down of nucleins. A stationary output of uric acid shows that the same amount of nucleins has been oxidized and if following the ingestion of large amounts of albumin or paranucleins there is no increased output of uric acid it shows that no nucleins have been synthesized by the ingestion of those bodies.

A further step was next taken by Burian and Schur (8) to clear the relation of uric acid in metabolism. They showed that the uric acid excretion could be sharply divided into two fractions, the exogenous and the endogenous uric acid. By the conception "exogenous uric acid" they mean that part which arises from oxidation from the purin constituents of the foods, while endogenous corresponds to that part which arises from oxidation of the nucleins of the body, that is, from the breaking down of body cells. The determination of the endogenous part of the uric acid leads us to an estimation of the consumption of the body tissues; its estimation is a very easy one. The organism is for some time placed on a purin-free diet, which, however, covers its need in nitrogen and heat. In this way one obtains a very constant excretion of uric acid, which corresponds to the regular consumption of tissue cells. This is the method which we applied in our work to estimate the cell changes in leukæmia and which combined with the influence of the food on uric acid excretion, leads to the discussion of the question, whether the adult body can synthesize nucleins.

A second way of approaching our problem in the case of the leukæmic patient is afforded by the absolute leucocyte count. An increase would speak in favor of a new formation, a diminution for the destruction. We should expect continued nuclein-poor food to be followed by a diminution, a nuclein-rich diet by a rise, in case the synthetic formation of nuclein material were dependent on the nuclein content of the food. Since the life of a single leucocyte extends over about three weeks, it follows that in each day about five per cent of them are destroyed. Supposing that these were not replaced by new ones, as would be the case if the organism were unable to synthesize the nuclein material, about one-third of the total leucocyte count would be destroyed in a period of six days (the length of time which we chose as periods in our studies). On the other hand, the blood during a nuclein-rich diet would be flooded with new-formed cells.

There is one objection, and a very well-founded one, against the use of this method. We cannot be sure that a drop in the leucocyte count means a destruction and a rise corresponds to a new formation of white blood corpuscles; a variation in the leucocytes very often means only a change in the distribution of the internal and peripheral blood. We sought to diminish the errors caused by those changes, in counting the blood as often as possible under absolutely similar conditions as regards time, food, etc.

In still another way have we tried to control the accuracy of our counts, that is, in comparing the results of the differential count with the absolute number of leucocytes. It stands to reason that a mere change in the distribution of the leucocytes would not influence the differential count. On the other hand, if a rise in the number is accompanied by an augmentation of the cells which are characteristic for the special form of the disease, it seems to indicate an increase and new formation of white cells. Analogously, a catabolism of cells in leukæmia would first destroy the pathological cells as the most available for consumption and a decrease in the count would be followed by a gradual change of the blood picture to the normal.

In the above indicated way have we sought to avoid the errors inherent in the count of leucocytes.

Before, however, we begin the study of the nuclein metabolism in leukæmia, we must know what effect the leukæmia itself has upon metabolism. This question has been the object of very many recent observations by different authors, and their results lead us to the conclusion that we must separate sharply the conditions of metabolism in the two forms of leukæmia, that is, the acute and the chronic. While in the acute leukæmia the destruction of the tissues continues progressively until death and leads to tremendous loss of tissue proteid, in the case of the chronic a totally different condition exists. It is possible, if we except those periods of acute exacerbation of the disease, to so feed the patient that he preserves an equilibrium of albumin metabolism and of body weight, as the work of Magnus-Levy (9), Lowi (10) and others have shown. The most marked anomaly which chronic leukæmia shows was discovered a long time ago before the connection between nuclear destruction and uric acid excretion was recognized, that is, an increase in the uric acid output, which Bartels (11) showed in the case he published, in which the excreted amount was nearly three grammes per day. This fact was confirmed by many others, and Magnus-Levy (12) has even published a case in which the uric acid reached the record point of eight grammes in twenty-four hours. There are, of course, some cases in which this anomaly is much less marked. It stands to reason that the uric acid output is only an indication of the amount of white corpuscles destroyed in metabolism. If this amount is a very limited one, as may occur in cases with a low leucocyte count (see our case P.), or even in cases with a high number of white corpuscles but a limited destruction, then, of course, the output of uric acid is only a bit above normal or even normal.

A second product of increased cell destruction we must consider are the xanthin bases. Their relation has recently been the subject of careful study with the result that their excretion in general is increased above the normal. The interesting fact has been brought forth in several cases that in the amount of uric acid and of the xanthin bases excretion there is a certain amount of antagonism; that is, when the amount of uric acid diminishes that of the xanthin bases

rises, and the reverse; while the sum of these amounts is fairly constant. For some time it has been a question whether in leukæmia the ability to destroy the xanthin bases is diminished or entirely stopped. Experiments performed by Bondsynski and Gottlieb (13), as well as those of Schmid, were undertaken in this connection. They fed methylated xanthin bases, that is, theobromine, caffein, etc., and showed that these bodies are as completely oxidized in the leukæmic as in the normal body.

To review, we see that in the case of a chronic leukæmic patient the following conditions obtain: The body on a sufficient diet is kept in equilibrium as regards nitrogen and body weight; the uric acid excretion is commonly increased corresponding to the increased leucocyte destruction, while in other cases, in which the destruction is within normal limits, the uric acid excretion is also normal.

A case of lymphatic leukæmia and one of the myelogenous variety, both chronic cases, were studied. Both were in the period of intermission with a very low count of leucocytes; in the lymphatic patient about 50,000; in the myelogenous, 10,000. In the first case I made continuous observations on the composition of the urine and used the second more as a control, since, on account of his low leucocyte count, a pathological metabolism of the purin bodies could not be expected. Concerning the methods used, I would say that the patient received a carefully-weighed diet. The urine was quantitatively collected each morning and examined while fresh. The total nitrogen was examined by the Kehldahl method, the uric acid according to the Ludwig-Salowski, and with the modification that the amount of uric acid was not determined gravimetrically, but by its nitrogen content. The purin bases were estimated according to Arnstein-Kamerer, and the phosphoric acid by trituration with uranium nitrate.

John C. W——, 46 years old. At the first admission in January, 1903, he complained of swelling in neck, axilla and groins. He had malaria about eight years ago, but without chills; grippe about four years ago. About fourteen years ago he was bruised on the left side just below the ribs by getting crushed while making a coupling as a brakeman on the railroad. He was, however, not injured enough to prevent his working. He first noticed a swelling under the right and left sides of the jaw about four years ago. During the last year several nodules appeared in the neck, axilla and groins, growing very rapidly in size; he never noticed, however, an increase in the size of the abdomen. On admission an enlargement of the glands of neck, axilla, groins and the perineum was found. The spleen attained a very considerable volume, descending far below the navel. An examination of the blood showed the following proportion of different leucocytes:

Polymorphonuclear neutrophiles	7.6%
Small mononuclears	84.9%
Large mononuclears	5.5%
Transitional forms	0.5%
Polynuclear eosinophiles	0.5%
Mastcells	0.8%
Myelocytes	0.2%

4 normoblasts.

The number of red blood corpuscles amounted to 2,916,000; hæmoglobin, 59 per cent; leucocytes, 41,600.

On the second admission, in November, 1903, there was no noticeable change in his general condition. In April he injured the left big toe and developed a blood poisoning, for which he was operated on in a neighboring hospital. After a large incision and removal of much necrosed tissue, he seemed well, but a month afterward he had a suppuration in his right thigh; after incision 1½ pints of pus were removed. During the last week before entering the hospital he had a swelling of the feet. During the whole time he has taken Fowler's solution.

On entering the hospital his condition was as follows: glands about the same size as on last admission; spleen rather larger, reaching the symphysis.

The examination of his blood showed the following results:

Red blood corpuscles	3,204,000
Hæmoglobin	54%
White blood corpuscles	25,450

Differential count:

Small and large lymphocytes	66.5
Polymorphonuclears	26
Eosinophiles and Mastcells	0.5
Transitionals	1.0
Myelocytes	1.2

1 nucleated red.

The time of the investigations began Nov. 25, and was divided into four periods. During the first period the patient received a mixed diet, consisting of eggs, albumin, milk, bread, meat and vegetables, a diet as similar as possible to that to which he was accustomed. Excluding certain items and increasing the milk, the patient in the second period received a practically purin-free diet, consisting of milk, eggs and bread. This diet was continued for six days. Then the former diet was resumed in the third period. It consisted of the previously given amount of milk, eggs and bread, together with from four to five hundred grammes of meat in order that an appreciable increase in the uric acid and purin bases might be obtained. During the fourth period thymus was substituted for the meat. Hence, this diet was eminently rich in nucleins. Of course, it was not possible that the patient should receive every day exactly the same amount of food, and hence he was allowed to eat as much of the menu as he wished, and the unconsumed food was again weighed and subtracted. I have not determined the amount of nitrogen in the food, since for our purpose it was not of very much moment, but have tried to keep the heat value fairly constant. The results obtained are the following:

1st Period, Nov. 25. Leucocytes, 23,500.

Lymphoc. small and large	76%
Polymorphonuclears	21%
Eosin. and Mastcells	1%
Transitionals	1%
Myelocytes	2%

Nov. 27. Hæmoglobin, 49%. W. B. C., 29,000.

Lymphoc. small and large	71.3
Polymorphonuclears	27.5
Eosinophiles and Myeloc.	1.2

2d Period, Nov. 29. R. B. C., 3,420,000. Hb., 52%. W. B. C., 44,600.

Small Lymph.	72%
Polymorphonuclears	22%
Large mononuclears	3%
Myeloc.	1%
Eosinophiles and Mastcells	2%

No nucleated reds.

Dec. 2. W. B. C., 39,500. Hb., 58%.

Small Lymphoc.	68%
Polymorpho. Neut.	25%
Large Mononucl. and Trans.	5%
Myeloc.	1%

No nucleated reds.

Dec. 4.

Small Mononucl.	75.9%
Large Mononucl. and Trans.	1.6%
Eosinophiles	78%
Polym. Neut.	18%
Mastcells	0.2%
Myeloc.	3.6%
Normoblasts	3 in 1000

3d Period, Dec. 6. W. B. C., 45,000. Hb., 56%.

Small Lymphoc.	82%
Large Lymphoc.	3%
Polymorphonuclears	14%
Myelocytes	1%

Dec. 7.

Small Lymph.	80.5%
Large Lymph.	3.3%
Polymorphonuclears	14.2%
Myeloc.	2%

Dec. 8. R. B. C., 4,444,000. W. B. C., 91,300. Hb., 60%.

Small Lymphoc.	80.5%
Large Lymphoc.	3%
Polymorph. Neut.	13.8%
Myeloc.	2.5%

Dec. 9. R. B. C., 3,552,000. W. B. C., 70,800. Hb., 58%.

Dec. 11. W. B. C., 66,000. Hb., 62%.

Small Lymphoc.	63.2%
Large Lymphoc.	4.0%
Polymorph. Neut.	20.5%
Eosinophiles	0.5%
Myeloc.	4.5%
Mastcells	1.3%

4th Period, Dec. 13. W. B. C., 56,400.

Dec. 15. R. B. C., 3,448,000. W. B. C., 76,800. Hb., 52%.

Small Lymphoc	87%
Large Lymphoc and Trans.	3%
Polym. Neut.	8%
Myeloc.	3%
Mastcells	0.2%

Normoblasts, 5 in 500 counted.

Dec. 16.

Polym.	10.8%
Mononuclears	87.8%
Large and Trans. Mononuc.	0.6%
Eosinophiles	0.4%
Myeloc.	0.4%

AVERAGE OF THE FOUR PERIODS.

I Period. R. B. C., 3,204,000. Hb., 54%. W. B. C., 26,250.

Large and Small Mononucl. and Trans.	73.3%
Polynuclear Neut.	24.8%
Eosin. and Mastcells	0.7%
Myeloc.	1.2%

II Period. R. B. C., 3,420,000. Hb., 55%. W. B. C., 41,500.

Large and Small Mononucls. and Trans.	75.2%
Polynuclear Neut.	21.7%
Eosin. and Mastcells	1.0%
Myeloc.	2.1%

III Period. R. B. C., 3,998,000. Hb., 60%. W. B. C., 68,800.

Large and Small Mononucls. and Trans.	79.8%
Polynuclear Neut.	18.6%
Eosin. and Mastcells	1.0%
Myeloc.	3.6%

IV Period. R. B. C., 3,448,000. Hb., 52%. W. B. C., 56,600.

Large and Small Mononucls. and Trans.	89.2%
Polynuclears Neut.	9.4%
Eosin. and Mastcells	0.3%
Myeloc.	1.1%

	Urine.	Sp. Gr.	N.	Ur. Ac.	All. N.	All. Bas. N.	P_2O_5	Diet.
Nov. 25	670	1028	9.623	0.516	0.274	0.102	1.889	Mixed.
" 26	650	1026	9.10	0.541	0.243	0.062	1.50	"
" 27	610	1027	9.65	0.589	0.239	0.043	0.878	"
" 28	610	1022	8.796	0.056 / 0.576	0.171 / 0.348	0.152	1.81	Milk & eggs.
" 29	1660	1019	20.467	1.095	0.525	0.160	4.84	"
" 30	840	1025	13.148	0.566	0.292	0.103	3.868	"
Dec. 1	1150	1025	18.899	0.554	0.328	0.143	4.945	"
" 2	830	1026	14.711	0.474	0.295	0.137	3.345	"
" 3	1100	1025	18.541	0.517	0.245	0.066	3.41	"
" 5	1320	1024	25.275	0.765	0.306	0.048	5.078	Meat.
" 6	1010	1023	18.523	0.373	0.144	0.02	2.97	"
" 8	1000	1023	19.315	0.602	0.23	0.06	3.80	"
" 9	1150	1026	23.333	0.77	.. .	....	4.54	"
" 10	1140	1029	22.407	0.88	0.392	0.098	4.43	"
" 11	990	1023	14.108	0.42	0.22	0.08	2.74	"
" 12	1320	1026	27.914	0.964	0.433	0.104	4.894	Sweet bread.
" 13	1290	1025	23.308	1.175	0.588	0.196	5.585	"
" 14	1020	1024	18.107	1.01	0.469	0.099	3.81	"
" 15	1020	1024	17.478	1.141	0.592	0.152	4.794	"

	1st Per.	2d Per.	3d Per.	4th Per.
N.	9.149	15.760	20.49	21.652
Ur. Ac.	0.547	0.544	0.635	0.078
Pur. f.	0.252	0.309	0.258	0.505
Alb. con.	0.069	0.132	0.055	0.188

DIET.

											Cal.
Nov.	25, 6 eggs, egg albumin, 250 gr. meat, vegetables, mild, bread.										
"	26										
"	27										
"	28	Milk,	2150	Eggs,	9	Bread	50				2150
"	29	"	3200	"	8						2790
"	30	"	3200	"	7						2790
Dec.	1	"	2800	"	8						2118
"	2	"	3200	"	8						2790
"	3	"	3200	"	6						2790
"	5	"	1500	"	5	Meat	500,	Bread	200, Butter	70	2097
"	6	"	2100	"	4	"	390	"	.... "	60	2709
"	8	"	1500	"	5	"	500	"	200 "	70	2745
"	9	"	1300	"	4	"	380	"	200 "	50	2147
"	10	"	1500	"	5	"	500	"	200 "	50	2543
"	11	"	1700	"	4	"	470	"	200 "	10	2011
"	12	"	1700	"	4	Sweet br.	420	"	200 "	50	2865
"	13	"	1700	"	4	"	330	"	200 "	50	2657
"	14	"	1700	"	4	"	480	"	200 "	50	2827
"	15	"	1700	"	4	"	360	"	200 "	50	2496

I would like to make a few observations concerning this case of leukæmia, and the changes in the blood picture which were observed during his stay in the hospital.

From the general picture of the case there can be no doubt that it was a case of chronic lymphatic leukæmia, but with some unusual features. There can be little doubt that the large spleen, which practically occupied the whole abdomen, is a very rare event in the history of those cases. Analogous cases have been described by Pappenheim (15), but seem to be very rare. In our case the enlarged spleen was combined with myelocytes, which reached during his stay in the hos-

pital a percentage of about 3½ per cent. Dr. Simon kindly communicated to me the different counts, which he made during the disease before admission to the hospital; they showed that at the beginning there were none, but about one year ago the myelocytes appeared in the blood picture and have increased since. There can be no doubt that the case, being at the beginning a regular case of lymphatic leukæmia, has presented since some features of the myelogenous type and is to be looked upon as a mixed case.

Concerning the changes in the total count and in the differential count, the following may be said: there can be little doubt that during the course of the experiment the condition of the case became worse. This is shown by the increase in the leucocyte count, and by the increase in the mononuclear cells relative to the polynuclear cells. We believe this is due to the new formation of these cells. This increase involved the total number of the leucocytes, as well as of the lymphocytes and the other cells arising in the bone marrow, the myelocytes.

I will now give a short history of the second case studied, a case belonging to the myelogenous group.

David P——, 29 years of age; complains of weakness. The disease began with a heatstroke three years ago; he felt weak for about three months, fainted nearly every day. Since then he was not able to attend to hard work. The enlargement of the spleen was first noticed about a year ago. On examination nothing pathological was found, with the exception of a tumor of the spleen, which reached nearly to the symphysis and extended to the right, a little beyond the navel. R. B. C., 3,329,000. W. B. C., 443,000. Hb., 49.

Myelocytes	64.2%
Polymorph. Neut.	31.6%
Mastcells	2.0%
Eosinophiles	0.56%
Large Mononcls.	0.18%
Small Mononcls.	0.18%
Nucleated red	1.1%
Normoblasts	0.55%
Megaloblasts	0.30%
Transitionals	0.19%

After having been in the hospital one month, he took Fowler's solution for about ten months. On second admission, Dec. 7, 1903, the spleen was considerably reduced in volume, reached median line at the navel, stopped at the ant. sup. spine.

Blood. 3,072,000 R. B. C. 9,700 W. B. C. 51% Hæmoglobin.
Differential blood count:

Polym. Neut.	73.7%
Trans. and Large Mononucls.	3.2%
Small Mononucls.	4.9%
Eosinophiles	4.5%
Myeloc.	4.7%
Mastcells	9%

In this patient analogous observations were made, as in the previous case, in order by changes of diet to cause changes in the blood picture. In this case so much attention was not paid to the urine, since, because of the very slight number of leucocytes, a change in the nuclein metabolism was scarcely to be expected. I made a sufficient number of analyses to justify this opinion, as, for example, the uric acid excretion on the 12th of December, the amount of urine being 1120 c. c. and the nitrogen output 12.1 grammes, was only .17 gramme.

First period. The patient received during this period a purin-free diet consisting of milk, eggs and of 100 grammes of bread.

Diet.	Dec. 8	Milk,	3200	Eggs,	8
	" 9	"	3200	"	8
	" 10	"	3200	"	8
	" 11	"	2400	"	5
	" 12	"	3600	"	8

During this period the blood showed the following conditions:

Dec. 9	W. B. C.,	7,200
" 10	"	8,600
" 12	"	6,000

Differential count:

Polym. Neut.	70.8%
Large Mononucls. and Trans.	3.6%
Small Mononucls.	3.8%
Eosinophiles	3.8%
Mastcells	7.6%
Myeloc.	8.0%
Doubtful cells (approach Mastcells)	2.4%
Nucleated reds, Normoblasts	11
Transitionals	7
Megalobl.	2

Average:

Leuc.	8,800
Polym. Neut.	72.2%
Trans. and Mononucls. Large	3.4%
Small Mononucls.	3.4%
Eosinophiles	4.1%
Myeloc.	6.5%
Mastcells	8.4%
	100%

During the second period a part of the milk was exchanged for thymus and so an extremely purin-rich food was obtained.

Diet II.	Milk	Bread	Butter	Eggs	Sweetbread
Dec. 13	1900	200 gr.	50 gr.	4	375 gr.
Dec. 14	1100	200	40	3	475
Dec. 15	1600	200	50	4	450
Dec. 16	1600	200	50	4	430
Dec. 17	1500	200	50	4	460
Dec. 18	1600	200	50	4	380

The blood composition was as follows:

Dec. 14. W. B. C. 15,600.

Polym. Neut.	53.1%
Large Mononucls. and Trans.	3.5%
Small Mononucls.	5.2%
Eosinophiles	1.5%
Myeloc.	25.4%
Mastcells	8.2%
Doubtful	2.5%

Dec. 15. W. B. C. 10,100.
Differential count:

Small Mononucls.	5.0%
Large Mononucls. and Trans.	4.2%

Polym. Neut.	40.6%
Eosinophiles	6.6%
Myeloc.	26.9%
Mastcells	16.3%
Dec. 17.	
R. B. C.	3,616,000
W. B. C.	10,400
Hæmoglobin	62%
Dec. 19.	
W. B. C.	12,600
Polym. Neut.	35.5%
Large Mononucls. and Trans.	3.2%
Small Mononucls.	7.6%
Eosinophiles	1.4%
Myeloc.	45.1%
Mastcells	7.4%
Normoblasts	6
Average:	
W. B. C.	12,200
Polym. Neut.	43.3%
Large Mononucls. and Trans.	3.6%
Small Mononucls.	5.9%
Eosinophiles	3.2%
Myeloc.	32.4%
Mastcells	11.5%
	99.9%

During the third period the patient received the ordinary ward diet with a daily amount of 500 grs. of meat. The count at the end of the third period was as follows:

R. B. C.	4,016,000
W. B. C.	100,000
Hb.	62.0%
Differential count:	
Polym. Neut.	46.8%
Trans.	14.2%
Myeloc.	26.6%
Eosinophiles	0.9%
Mastcells	6.5%
Lymphocytes	1.3%
Large Lymphocytes	3.7%
	100.0%

2 normoblast and 1 megaloblast.

In this case we were dealing with one of typical myelogenous leukæmia in a stage of remission. The number of leucocytes exceeded the normal either not at all or only slightly, and yet the blood picture was unquestionably that of myelogenous leukæmia. The high percentage of myelocytes and among these of the eosinophile myelocytes, of which there were a goodly number, the large number of Mastzellen, and the numerous megaloblasts, left no doubt concerning the nature of the process underlying these blood changes. Such intermissions in the course of leukæmia are not very rare and during the last years many have been reported. We received the impression that the continued use of arsenic in this case explains in part at least the improvement of his condition.

Consideration of the influence of changes in diet on the leucocyte count in both observed cases shows that the blood picture changes decidedly for the worse following the change in diet. In both cases the differential count shows considerable increase in the number of those cells characteristic of the special form of the disease. For instance, in case W. are seen the following relations:

Period		Leuc.	Lymphocytes
1	Mix. norm. diet	26,500	73.3%
2	Purin-free, albumin-rich diet	41,500	75.2%
3	Mixed purin, albumin-rich	68,300	79.8%
4	Purin-rich and albumin-rich	66,600	89.2%

In case P. the changes produced were as follows:

Period		Leucocytes	Myeloc.	Mast
1	Purin-free	8,800	6.5%	8.4%
2	Purin-rich	12,200	32.5%	11.5%
3	Purin-poor	100,000	26.6%	6.5%

A consideration of these tables leaves no doubt in our minds that as a result of an albumin-rich diet, the number of leucocytes is increased. Differential counts show an accentuation of the pathological blood picture. But one might object that the changes in the peripheral blood picture would hardly allow us to draw conclusions concerning the general composition of the blood. Such an objection has surely some foundation. Its weight is, however, not great, since each figure is the average of several counts and in both cases the influence of the diet had a parallel effect on the blood count and on the morphological changes of the blood picture, and both of these elements indicate that the patient is getting worse. If we seek to determine which factor in the nourishment is responsible for the above, we must conclude that a definite relation exists between the composition of the diet and the relation of the leucocytes. An albumin-rich diet acts as a stimulus to the formation of leuocytes. An increase in the amount of albumin results in an increase in the number of the white blood corpuscles. The particular kind of albumin seems to have no particular influence on this new formation, for when a normal mixed diet in Period 1 was replaced by an albumin-rich but purin-free diet, the leucocytes rose from 26,500 to 46,500. Following the transition from albumin-rich, purin-poor diet, Period 3, to a purin-rich diet there followed a fall from 68,300 to 66,600. In case 1 the transition from purin-rich diet, Period 2, to the purin-poor but albumin-rich diet, Period 3, was followed by a rise from 12,200 to 100,000.

Hence, the clinical observation does not speak in favor of a connection between the sort of albumin and the nuclear formation since he is able from any albumin-containing material to obtain the material for the new formation of nuclei. This view is corroborated by the observation of the metabolism in Case W. I would like here to give a short résumé of the results which we have obtained in this case:

Period		N	Uric acid	Purin N
1	Mixed diet	9.49	0.54	0.25
2	Purin-free	15.76	0.54	0.30
3	Albumin-rich, purin-poor	20.49	0.63	0.26
4	Purin-rich	21.62	1.08	0.51

What conclusions may we draw from these figures? The endogenous fraction, determined by the method of Burian and Schur, amounted in Period II to 0.54 grammes per day.

In adding to the purin-free food in Periods I and III moderate amounts of nucleins in the food, we do not obtain a rise in the excretion of uric acid and the purin bases. How is it to be explained? In our opinion hardly any doubt can arise that the amount varying in the three periods between 0.54 to 0.61 gr. per day is principally due to the breaking down of the leucocytes. To build the material for the new formation the organ uses the nucleins, if there are any present in its food; if not, he uses the other proteids to synthesize those bodies. Therefore the amount of broken-down nuclein material is fairly constant, while its origin is different. The organism prefers to draw upon preformed nuclein material; but if it is not able to get it, it is perfectly able to synthesize it.

The amount of synthesized nuclein can be estimated by the difference in the output of uric acid. In the first period we should have, according to Burian and Schur, an increase of 0.15 gr., in the third period of 0.30 gr. above the endogenous fraction of 0.54 gr.

In period IV the nuclein material in the diet more than covered the requirements of the organism and there occurred an increased output of uric acid corresponding to the increased supply. In any case this period confirms our belief that the organism had no tendency to store up nuclein material, but that the amount over and above its needs was oxidized and excreted.

Also from these figures we may conclude that the organism builds up its cells from any albuminous material furnished in the diet, and that it is able to cover its needs in nuclein from any albumin.

My results are confirmed and illustrated by three facts I have been able to find in literature.

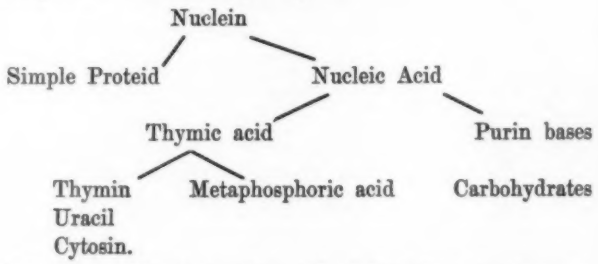
The first one, which approaches most the technique of my work, is contained in the report of Van der Wey (16). He fed to a leukæmic patient for a period of 22 days a diet entirely free from purin bodies. The leucocyte count during the experiment varied between 175,000 to 295,000; and the average of the uric acid output was 1.36 gr. The case would be an absolute proof for the formation of nucleins out of nuclein-free bodies, if the organism had kept its body weight and its nitrogen equilibrium, but during the duration of the experiment the body lost about 91 gr. of N. and 3.1 Kos. in weight. So, the objection may be raised that the nucleins destroyed in metabolism were formed from the tissue nucleins. It does not seem very probable because the amount of destroyed nuclein is much larger than would correspond to the amount of broken-down tissue cells.

An absolute proof for the synthetic formation is given by the work of Socin (17). He was able to feed mice on a purin-free diet (yolk of an egg) for an indefinite time. Therefore it is sure that those animals have synthesized the new-formed nuclei out of a purin-free diet.

In a very similar way the synthesis of nucleins is proven by the observation of Hausermann (18). He described the case of a young man 18 years old who had lived his whole life on milk and bread. He was normally developed and did not present any pathological features with the exception of a slight anæmia (hæmoglobin, 60 per cent). This case proves without discussion the possibility of the synthetic formation of nucleins.

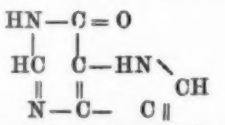
How shall we account for the synthesis of nucleins from the chemical standpoint? Nuclein consists of albumin and nucleic acid. Since albumin is abundantly present in all foods, our question resolves itself to the simple form, is the human organism able to form synthetically nucleinic acid? A closer consideration of the composition of this acid will permit us to get a clearer view of this question. The result of the splitting up of nucleinic acid gives us on the one side the four purin bases, adenin, guanin, xanthin and hypoxanthin; and on the other side, thymic acid. This latter yields by further cleavage, according to its origin, cytosin or thymin or uracil, together with metaphosphoric acid and carbohydrates, which may belong either to the hexoses or pentoses.

A graphic representation of the cleavage of the nuclein is attempted in the following diagram:

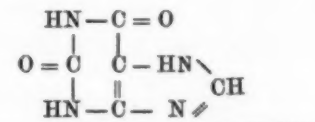


Now it is without question evident that the organism can obtain from its food an abundance of metaphosphoric acid, carbohydrates and albumin. For this synthetic formation of nucleic acid it needs only the purin bases and the uracil group.

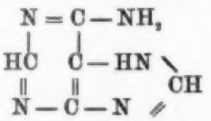
To consider first the purin bases: these are all to be looked upon as derivatives of purin.



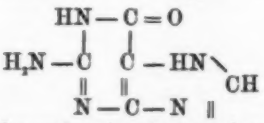
Hypoxanthine = 6 oxypurine



Xanthin = 2-6 oxypurine



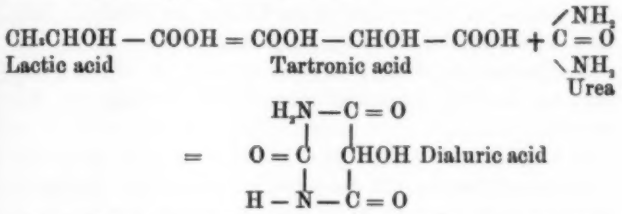
Adenine = 6 amniopurine



Guanine = 2 amino 6 oxypurine

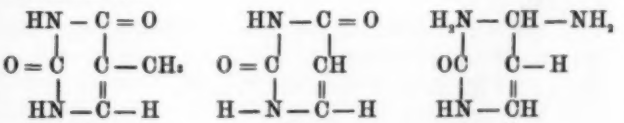
The question whether this purin ring can be synthetically built in the body is a very old one and one some time ago answered by Minkowski (19) in the affirmative, who demonstrated that in the case of birds the purin ring is synthesized from lactic acid and ammonia. He showed that after the extirpation of the liver, birds excrete instead of uric acid ammonia and lactic acid, a synthesis which is perfectly analo-

gous to Horbacsewsky's (20) artificial synthesis from trichlorlactic acid. This question was further considered by Wiener (21), who demonstrated that in the case of birds all dibasic acids with a chain of three carbon atoms, if administered simultaneously with urea, can form uric acid. The most efficient of these acids was tartronic acid and its ureid, dialuric acid, and only these two bodies could be transformed to uric acid by the isolated organs. Since, however, in the case of extirpation of the liver, an animal excretes not these acids, but lactic acid, we must suppose that lactic acid is oxidized to tartronic acid before the formation of uric acid, which combined with urea yields dialuric acid.

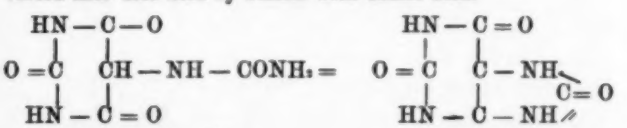


This dialuric acid then enters into a further combination with urea and forms uric acid. Based on these observations, Wiener then attempted to demonstrate the synthetic formation of uric acid in the case of mammals in feeding dibasic acids with a chain of three carbon atoms, but the increase in the excretion of uric acid was so slight that the difference was within the limits of experimental error. We cannot admit that in the case of man the synthetic formation of purin was proven by these experiments. We must conclude, therefore, that for man the synthetic formation of the simple purin ring has not yet been proven.

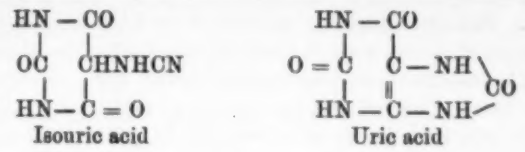
If we consider the other constituents of nucleinic acid, namely, thymic acid, we find that its cleavage products are cytosin, thymin and uracil. Concerning these, the investigations of the Kossel school have demonstrated the remarkable fact that all three bodies are to be considered as derivatives of the pyrimidin ring. The graphic formulæ of these products are as follows:



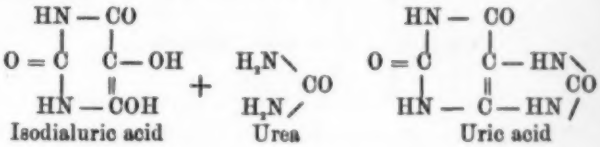
The pyrimidin derivatives are characterized by the remarkable ease with which they unite with the urea molecule and thus form derivatives of the purin ring, as is proved by the following synthesis of uric acid. The pseudo-uric acid is converted into uric acid by fusion with oxalic acid.



In like manner, isouric acid yields uric acid if boiled with hydrochloric acid.



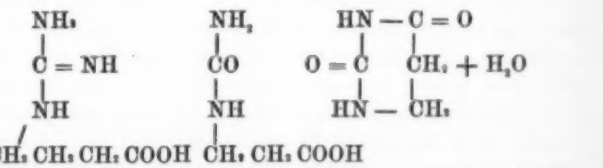
Analogously, Behrend and Rogsen have formed uric acid from isodialuric acid and urea.



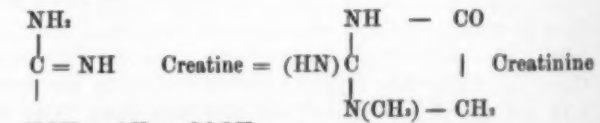
We have already mentioned the dialuric acid in connection with Wiener's work. He was able to demonstrate in the case of birds that this acid forms uric acid by synthesis with urea.

The question, therefore, of the synthetic formation of nucleinic acid resolves itself to the simple question whether the organism obtains its pyrimidinring by synthesis or whether it gets it preformed in the food, for there is no doubt that the organism can form the purin ring in case the pyrimidin ring is present. For the experimental proof of this conception, however, has Steudel given us no positive data; but the fact the pyrimidin derivatives given per os are not transformed into uric acid hardly proves that pyrimidin formed in metabolism is not used for the further formation of purin bodies. Then that the organism is able to build new products by synthesis with urea is abundantly proven by the formation of taurin, sarcosin, etc. The possibility of the synthetic formation of the pyrimidin ring is proven by several different reactions. As we have previously mentioned, lactic acid is oxidized to tartronic acid, which in turn combines with urea to form dialuric acid in which is present the pyrimidinring.

In like manner, β-ureidopropronic acid, the analogue of which, the guanidin butyric acid, Kutscher proved to originate from arginine, yields by hydrolysis uracil:

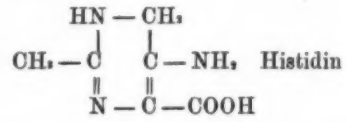


This process is perfectly analogous to the formation of creatinin from creatin.

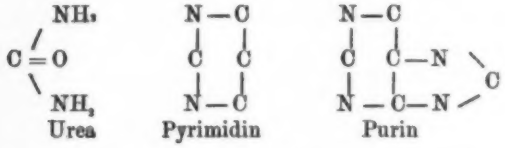


We may say, therefore, that the possibility of the synthetic formation of the pyrimidin ring from animo acids is to be

granted. But the organism does not even need the formation of the pyrimidin ring, since the same is furnished in the albumin. The important observations of Fraenkel (22) concerning the constitution of histidin, which is present in each albumin body, have proven to us that this is to be considered as a derivative of pyrimidin, and probably is represented by the following formula:



The organism, therefore, has at its disposal in any case the pyrimidin ring to build up the purin ring, and from this nucleinic acid and the nucleins. The simple relation of these bodies is best evidenced by the following scheme:



To review the preceding considerations, therefore, we see that the organism is always able by simple chemical processes to form the building stones of nucleic acid. That those are united and utilized for the building of the cell material we have been able to show in our preceding experiments.

The two cases, which we had at our disposal for decision of the question which we tried to answer, were not the most favorable ones. In both the number of leucocytes was not very high and in both also the destruction, judged by the uric acid output, was not very great. I intend to resume those investigations on nucleinic metabolism, should any more favorable cases present themselves.

Discussion.

Dr. Emerson.—This contribution of Dr. Schmoll's to our knowledge of the chemical origin of leucocytes deserves our careful attention. In the first place, there are few who can speak with greater authority concerning uric acid and the allied bodies, a subject which enters largely into the present question, than can he, for his earlier work on this subject is quite classical; it suggested and made possible the well-known work of Minkowski, and was recently described by Wiener as "brilliant."

In the second place, the present work is a very ingenious method of attacking an interesting subject; where does the adult body get the materials for the nuclei of its leucocytes? does it synthesize them, or borrow them directly from its food? Dr. Schmoll follows the purin ring. In the case of those containing this ring there is no doubt that the young bird and the young mammal can synthesize them. Can the adult man as well? Dr. Schmoll places the adult leukæmic on the diet of the young bird and infant, a purin-free diet, and follows the leucocyte count and uric acid output.

Unfortunately, the cases of leukæmia at his disposal were not very suitable cases; that is, had a low count and low output of uric acid. Nevertheless, the results are all in the right direction and we feel confident that further work will confirm them.

But the best part of the work is its suggestiveness, for this line can be followed in other directions, with, I am sure, interesting results.

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MENTAL PHENOMENA AND VISCERAL DISEASE.[1]

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We are all more or less familiar with the mental changes that at times take place in different pathological conditions. These may be due: (1) To changes in the blood in cardiac disease, or to vascular degeneration. (2) To poisoning resulting from disease of certain organs, as, for example, the kidney or the liver. (3) To the effects of alcohol and like poisons, either in acute or chronic form, by themselves, or in conjunction with diseases of the viscera. (4) To a change in some gland whose secretion is necessary to the normal metabolism of the body, for example, to atrophy of the thyroid with its resultant hebetude as seen in myxœdema.

These conditions are all of great importance and have not been sufficiently studied, although they have been recognized for a long time. It was known years ago that a definite and large proportion of heart cases developed what is known as insanity, but it remained for Henry Head, in an article written in 1901, to draw attention to a train of symptoms often seen in diseases of the different viscera of the body, which he looked upon as distinct from the changes mentioned above. Although I do not exactly agree with him in that view, his article has been of such great value in directing attention to a train of symptoms different from those heretofore described, it would appear presumptive to criticize the work he has done.

Head draws a distinct line between the conditions noted above and what he has made out by most painstaking care in examining his cases along the line of an article of his written in 1896. In this first article he draws attention to the fact that in diseases of the viscera there are in certain cases areas of reflected pain corresponding to the segmental distribution of the nerves over the surface of the body in relation to the viscera involved. Clinical observation has shown that Head is correct in his ideas. After establishing this point he was led to investigate, as he puts it, what effect the stimuli of such pains would have upon the mental condition, and he has divided the results of his observations into the following parts: (1) Hallucinations of sight, of hearing, of taste and of smell. (2) Moods of depression and exaltation. (3) Suspicion. (4) Loss of attention and memory.

From the standpoint of the general medical man this is of great importance, and I am inclined to believe that it is also of great importance from the standpoint of the modern alienist. For example, if we look upon insanity as simply a deviation from a normal mental condition, that is, mental sickness, and if we take into consideration the finding of these symptoms as related by Dr. Head in his article, and as is drawn out in the cases I am about to report to you, it is easy to see how closely connected the two fields are. That is, the work of keen observers in the medical world along the line of the mental as well as the physical signs would lead us to suggest at once that there is merely a difference of degree in the cases which we report and those which fill our insane asylums. At the same time, a thorough examination by clinical men, in active practice in hospitals, would go far toward studying out the first signs of mental wrongness. Thus, the work that is reported to you to-night is not only important along the line that Dr. Head has shown in his article, but it suggests a field that promises to be of advantage to the human race. If we could get away from the names that are appended to different mental conditions and simply bear in mind that many cases of mental illness start with different conditions of physical disease, we shall have gone a long way toward solving the condition of mental wrongness, and if this paper brings the active medical man, the man in private practice and in the hospital, to work along that line and to report his results, a good deal will be accomplished. For, strange as it may seem, in spite of the importance of the original work by Dr. Head, scarcely any notice has been taken of it in this country, and there is not much connected with this subject to be found in English medical literature. The Germans, on the other hand, have paid much more attention to the question and their alienists are greatly impressed with its importance.

The simplest way to bring before you these different phenomena is to read the histories of cases selected from a series which it has been my fortune to meet with.

CASE 1. *Mitral stenosis. Hallucination of sight.*

A colored woman, 30 years of age, was in my care at the City Hospital in June, 1902. Her cardiac condition dated back to an attack of inflammatory rheumatism in 1899. She came into the hospital on account of pain in the left breast and over the epigastrium. This pain was superficial, constant and, at times, severe. On several occasions, on going through the ward, I noticed that she was much depressed and the nurse informed me that the woman frequently cried without known cause.

[1] Read at the meeting of the Hospital Medical Society.

There were no signs of failing compensation and physically the woman was in fairly good condition. At first it was not possible to get any satisfactory information from her, but after a while the following history was obtained. Usually at dusk and early in the morning, and always after a severe paroxysm of pain, a figure would appear at the foot of her bed and peer at her. This figure was veiled, dark in color, and had two glaring black eyes which stared at her. She thought the figure was that of a woman, but could give no reason for that opinion. She was always frightened and felt her skin "creep," as she expressed it—the so-called goose-flesh. The figure would gaze at her for a time and then fade away. The woman thought that a spell had been cast upon her and that it meant some dire disaster. When the idea that an enemy had caused the figure was removed, as we succeeded in doing in time, the periods of depression and fear were banished.

CASE 2. *Asthma and hallucination of smell.*

F. S., male, æt. 44, has been subject to attacks of bronchial asthma since boyhood. For four years his attacks have been infrequent, and for the past year he has had none at all. He has never suffered any pain. For years he noticed that for 24 hours before an attack came on he could not drink coffee on account of its smell, which was like sulphuretted hydrogen to him. This sign was so invariable that he came to look upon it as a warning that an attack was approaching. An examination of his nose showed nothing pathological.

CASE 3. *Adherent pericardium. Hallucination of hearing. Alternating depression and exaltation.*

Ellen L., white, æt. 34, consulted me December 26, 1903. Ten years before she had had inflammatory rheumatism, from which she made a slow recovery, and she dated her cardiac trouble from that illness. Since then she has been subject to attacks of dyspnœa, weakness and pain over the precordium reflected back under the left shoulder-blade. With this reflected pain she has always had vertex headache. For three years past her attacks have been increasing in intensity, and for the last 12 months she has noticed at times swelling of the feet and cyanosis of the fingers. For four years past she has suffered from ringing in the ears. During the past twelve months, in addition to this tinnitus, she has waked up, always at night, with the hallucination of hearing the loud ringing of a bell. This ringing continues for about fifteen minutes after awakening. At first she thought the noise was real, but she came to the conclusion that this was not so, because there are no bells in her neighborhood, and she never hears them during the day. This phenomenon is generally manifested after a severe cardiac attack. For some time she has been subject to fits of depression, coming on without cause as far as she knows, and alternating with periods of physical exaltation. That is, after getting over the depression, she feels as if she could do a great deal of work, and frequently tries it, only to find that her strength is insufficient. This woman's hearing is unusually acute and there is no thickening or retraction of the ear drums.

CASE 4. *Mitral stenosis, adherent pericardium, alternating depression and physical exaltation.*

A white woman, æt. 35, with a history of rheumatism ten years previously, came under my care in St. Joseph's Hospital in 1896. She was suffering from the usual symptoms of failing heart strength, shortness of breath, cough, œdema of the extremities and cyanosis. She complained of superficial pain through the left breast and back. She was treated by rest and venesection and for the time rapidly improved and, with periods of acute dilatation, remained in the hospital for eighteen months, when in one of her attacks she died. At the autopsy there were the usual signs of right-sided cardiac engorgement, mitral stenosis of an extreme grade, with adherent pericardium.

After attending her in the hospital for six months and seeing her daily, I found her once with her head covered, crying quietly. On being questioned about her trouble she could assign no cause for it. She was depressed and wretched, but did not know at what, and told me she had been suffering more pain than usual the day before. Such periods were frequent but never came when she was suffering from one of her attacks of dilatation. As a usual thing she was of a cheerful disposition and was much liked in the ward. At times she would try to do things which she was physically unable to accomplish. She told me that on some days she felt as if she could work as hard as she could when she was strong and well. Her final fatal attack was brought on after such an effort.

In this case were present the two moods, depression and physical exaltation.

CASE 5. *White woman, æt. 30. Mitral stenosis, failing compensation, suspicion.*

This patient was also in St. Joseph's Hospital in the year 1898, and came into the house for practically the same reasons as Case 1. She too had an area of reflected pain on the left side of the chest, extending over the epigastrium to the liver. This pain was at times of great severity. She improved temporarily and was under observation for over a year. During her periods of greatest physical depression she was patience itself, but in her condition of physical betterment she was suspicious of everyone about her—the nurses neglected her, the doctors thought she was malingering, and, although these ideas would leave her for the time, thy would return afterward. This mood of suspicion was put down, unfortunately, as due to her disposition and dismissed as such. At the autopsy an extreme degree of mitral stenosis was found, with signs of venous engorgement. Both these cases occurred before there was any knowledge of such peculiarities, consequently they were not studied as closely as they should have been in regard to the hallucinations of sight, smell and hearing, and scalp tenderness.

The moods as shown in these two cases, depression and physical exaltation in one and suspicion in the other, are in my experience most common. Depression and suspicion, approaching at times to melancholia, are most marked in abdominal cases.

CASE 6. *Asthma. Emphysema. Loss of attention and memory and unreasoning fear.*

Mrs. S., aged 50, a woman of high intelligence and education. She has been subject to attacks of bronchial asthma for 35 years, and as the result of these attacks she has a decided amount of emphysema. Up to three years ago she did not suffer any considerable amount of referred pain and tenderness, but from that time with her attacks of asthma she has had a good deal of pain referred to the upper portion of the chest in front and under the left shoulder-blade behind. Coincident with this, she has complained of the following symptoms: First, of unreasoning fear. This fear is not at anything, but is vague and she is unable to account for it. Second, loss of attention and memory, especially in reading. She finds it hard to fasten her attention on her book, and her memory of what she has read in the past is defective. Neither of these deficiencies is persistent and her memory is only defective as regards things in the recent past.

These six cases represent the hallucinations of sight, smell, and hearing, the moods of depression and exaltation and suspicion, the loss of attention and memory and unreasoning fear. In a brief way let us look into Head's explanation of these phenomena.

Hallucinations.—The only necessary concomitant of an hal-

lucination is headache of the reflected type. At the same time the pain stimulus must be of a certain bulk, and the more suddenly the pain appears the more probable is the occurrence of the hallucinations. Again, liability to hallucinations is increased by the presence of pain over the trunk of the body. Head thinks the character of the hallucinations may be determined by the position of the headache. Thus, in herpes zoster ophthalmicus with frontal headache, there were found visual hallucinations; with vertex and occipital pain, auditory hallucinations; and with temporal headache and visceral disease, hallucinations of smell and taste.

Depression.—Depression is an alternation of feeling tone in the direction of ill-being and is not an intellectual condition at all. It is characterized by its lack of projection, and is different from the depression to which the normal individual is at times subject in that diversion is useless. The characteristic of this form of depression, according to Head, is the lack of projection. Thus the individual is not depressed at anything, but is just vaguely unhappy. To produce this condition, the pain must be of considerable intensity, or last for a long time and at the same time involve a considerable area. Painful areas over the abdomen are much more liable to be accompanied by this depression than those in other parts of the body. In other words, the higher the area of pain, the less common the depression.

Exaltation.—This is not accompanied by any increase in physical strength. It is a vague feeling that one is able to do more than before. It is not a delusion of grandeur; the patient is never anyone but himself. He only feels strong and well again. There may be several reasons for this condition:

1. It may be a swinging to the other extreme after a feeling of depression and referred pain has passed off.

2. It may be a constitutional condition. Those who are subject to visceral diseases are often more susceptible to waves of ill and well being than the normal individual.

3. The feeling of exaltation may be due to ignorance of the gravity of the condition.

4. It may be due to an organic heart disease. Patients with aortic valve lesions are subject to periods of excitement of purely vascular origin.

Suspicion.—To produce this phenomenon there must be reflected visceral pain and at the same time depression and unreasoning fear. It is an easy step from a condition of depression or fear without projection to a feeling of self-contempt, and from that to the idea that people around are thinking ill of one. This condition is, as are the others, marked by its vagueness and lack of projection. Head holds that the distinguishing mark of this condition from that found in the insane is the ease with which the suspicion is removed.

Loss of Attention and Memory.—In cases of this nature it is not always necessary to have reflected pain, for this condition is often found without pain, but the loss of memory follows the loss of attention. The individual is taken up, without knowing it, with his visceral existence. Thus, for instance, when the patient reads, his attention is not wholly fixed upon the book, but only partly. So, as a consequence, there is afterwards no memory of what is read. In the normal state the human being is taken up with outside conditions, but in disease peculiar to the viscera outside impressions are rendered fainter and in their place the individual becomes conscious of his own ill being.

These then are the explanations of the phenomena according to Dr. Head. His facts on the whole cannot be disputed, but let us go a step farther and compare with these cases, which are according to his descriptions, a few others which seem to me a step farther in the same process.

CASE 7. *Arterio-sclerosis. Loss of attention and memory. Confusional ideas.*

C. S., male, æt. 22, was referred to me by Doctor Paton. His family history was good except for the fact that his father died of tuberculosis. Five years ago he had typhoid fever, a moderately severe attack. He denies lues and has no scars or enlarged glands. For two years past he has not been able to fasten his attention on anything for more than a short space of time. He is depressed nearly always and is afraid he is going insane. His memory of past things is good, but the moment he attempts to do anything requiring concentration, his thoughts become confused. This man on examination showed a most remarkable condition of arterio-sclerosis for a person of his age. The apex of his heart was in the nipple line. His arteries were uniformly thickened and could be traced high up his arms. There was a marked accentuation of both cardiac sounds. His urine was negative. Blood pressure 200.

CASE 8.—A white man, aged 58, another case of bronchial asthma of years' duration, who suffered pain about the chest in front and back. He noticed about a year ago that he commenced to suffer from dreams. He was always half awake and the dreams always dealt with the same subject. He was fighting with a gigantic snake, and his awaking was always a sense of great relief to him, but within the last two or three months he is no longer relieved on waking and is commencing to think that the snake is a real, tangible object and is lying under the bed concealed somewhere. If you talk with him and tell him how unreal this is, he agrees with you, but in a little while goes back to the fact that the snake is under the bed and is going to attack him.

CASE 9.—A step further than this is the case of a motorman, æt. 35, suffering from aortic regurgitation, who at the first regarded his hallucination as mere incidents. The figures that he saw were generally indistinct and vague and were usually seen in the dusk of the evening or in the morning. Now the faces have taken distinct shape, are those of his relatives, many of them long since dead, and the man is beginning to believe that they tell him things about the future. This man will also listen and seem to be convinced, and then will come back to the point that he has the power of prophecy.

CASE 10.—Also another case of mitral stenosis, a woman, æt. 36, who for years has been able to go about and do her work fairly well. She has been subject to dreams and at first thought they were nothing but dreams and they were pleasant. Of late they become extremely disagreeable and vivid. She has long conversations with dead people, and she also thinks she has the power of prophecy. She feels that these voices tell her to do things and she is getting ideas of persecution. She can be talked out of them for a while, but she returns to the point again and recites them as facts, and she has once attempted suicide. Both of these last two cases had signs of beginning failure in cardiac compensation.

The similarity between these two series of cases is suggestive. In the first class the individuals can be easily persuaded that their hallucinations are hallucinations, or that their moods have simply a physical basis. In the second class, however, such persuasion becomes impossible. One would think at first that this point of difference might be a vital one, but when we consider that an idea by continually being present can become fixed in the individual's mind, it is easy to see how the gradation can take place from one class of cases to the other. Finding such a train of symptoms is only a matter of asking for them, but as Dr. Head has brought out, and as I wish to emphasize again, in asking such questions a certain amount of tact must be used and the confidence of the patient secured. Apart from the interest attached to such histories, lies the fact that these individuals come first into the hands of the general medical man and not into those of the alienists.

As a summing up of the work that has been done, we may say:

1. That Head has shown there are various phenomena at times connected with disease which have not heretofore been described.

2. That by the study of causes of disease we may be put upon the road which may lead us to the proper solution of many causes of insanity.

3. That many symptoms have been grouped under the head hysteria which should not be so placed. As far as our knowledge goes there is a neurasthenic condition, which as we study more exactly we will find to be allied closely to the condition of the viscera.

4. That mental illness and physical illness are closely allied to each other.

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1. Head, Henry: On Disturbances of Sensation, with Especial Reference to the Pain of Visceral Disease. Brain, 1896.

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PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

February 15, 1904.

The meeting was called to order by the President, Dr. Futcher.

A Simple Method of Obtaining Uterine Lochia for Bacteriological Examination. Dr. Little.

With the recognition of the bacterial origin of puerperal fever, and particularly of the fact that the prognosis in individual cases varies largely according to the character of the infecting agent, the taking of uterine cultures in all febrile cases has come to be a routine in hospital practise. The somewhat complicated technique necessary to obtain the uterine lochia without contamination, has undoubtedly interfered with its general employment, and is responsible for the resulting lack of appreciation of the necessity for surgical asepsis in ordinary obstetrics.

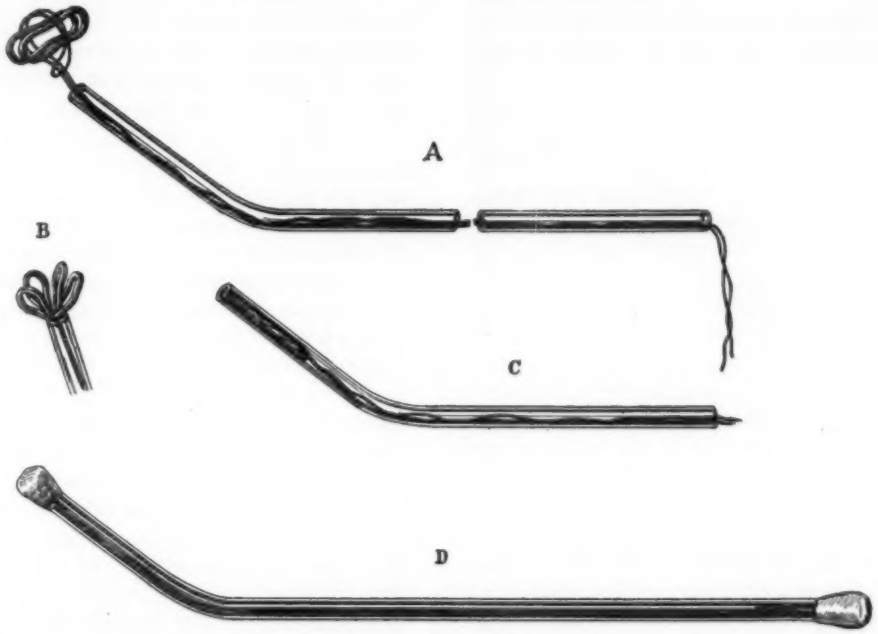
The procedure followed in the majority of obstetrical clinics, is that of Döderlein; i. e. the introduction into the uterine cavity of a curved glass tube, into which the lochia is aspirated by means of a syringe applied to its distal end. By this method a considerable amount of secretion can be secured, and an idea of its macroscopic character obtained. It, however, presents several disadvantages: first, the danger of contamination from the cervical secretion during its introduction; second, the difficulty of retaining the fluid in the tube when withdrawing it; and third, and most important of all, the invariable necessity for the use of an aspirator. Even when the latter can be sterilized, its attachment to the tube is often quite difficult, and an assistant is always required for its manipulation. Moreover, when the end of the tube infringes on the uterine wall, the plunger is sometimes drawn back violently by the negative pressure, and if the syringe has not been previously sterilized, bacteria can be aspirated from it into the tube if not into the cavity of the uterus. In other cases where too great a volume of air is exhausted from the barrel of the syringe and the end of the tube is freed, the lochia flows through the tube into the syringe itself. On the whole, the proceeding is very unsatisfactory.

To be perfectly satisfactory a method of obtaining cultures should overcome all these disadvantages, i. e. it should enable one to obtain a considerable quantity of the lochia with a minimum possibility of contamination from the cervix, should do away with the clumsy aspirator and finally should be capable of use without assistants, and without unnecessary disturbance of the patient.

The tube I wish to show you, combines all these advantages. As you will see from the drawings, it is a glass tube 20-25 cm. long and 0.5 cm. in diameter, with a lumen of 3-4 mm. It is curved slightly at one end to correspond to the shape of the uterus. Two small India rubber bands are tied in the middle with a stout silk thread, by means of which they are drawn well up into the tube, so that by traction on the thread they act as a plunger, each culture tube becoming in itself an aspirating syringe. Cervical secretion cannot enter the tube during its passage into the uterus, and the exhaust cannot be greater than the capacity of the tube. The instrument can be readily sterilized by boiling, and can be used without the necessity of an assistant, and the patient need be disturbed no more than for an ordinary vaginal examination. The pressure of the plunger in the distal end of the tube at the completion of the operation prevents the reflux of the obtained lochia,

and the application of sealing wax to each end of the tube renders it fit for transportation to the laboratory without danger of contamination.

I have used this method in over a hundred instances and so far it has given great satisfaction.



The Differential Diagnosis and Treatment of the so-called Rheumatoid Diseases (An Abstract). DR. JOEL E. GOLDTHWAIT.

The result of the study of a large number of cases of non-tubercular joint disease commonly spoken of as chronic rheumatism, rheumatoid arthritis, arthritis deformans, osteo-arthritis, gouty rheumatism, etc., seems to show that there are several distinct types of disease which can be differentiated both pathologically and clinically, and which require essentially different forms of treatment.

The characteristics of these forms of disease are so unlike that they apparently represent distinct diseases, and while it is not possible to entirely disprove any connection between them, for study, at least, they can best be considered as distinct conditions.

Of these types there are five which have been separated.

Chronic villous arthritis—uncomplicated.—The first type, variously spoken of as the dry, hyperæmic, or relaxed joint, really represents a villous arthritis, and while this villous type of synovial lesion may be present in any form of chronic joint disease, in this type it represents a purely local process and is not a manifestation of a general disease. The condition is seen usually in the knee, and is characterized by crepitus or creaking on motion with pain and tenderness on use. The structures of the joint are usually relaxed, the crepitation being due to the folds of the loose, flabby, and passively congested membrane rubbing together. At times under the continued irritation the folds become still further relaxed and fringes or loose tabs result. These may degenerate with the formation of lipomata. The fringes or villi at times interfere with joint motion and catch or lock the joint. The joint fluid in this class of cases may be normal or in excess if there be great irritation.

The treatment consists in the early stages in stimulating treatment locally with relief of any joint strain, and with bandages to steady the joint and limit the motion. If the villi or the lipomatous change is marked, these features should be removed by operation.

The process does not naturally tend to extend to other joints.

Atrophic, or *rheumatoid arthritis,* is a progressive disease, the ætiology of which is not known, characterized by swelling of the affected joint in the beginning, with a very early atrophy, which becomes more marked as the swelling subsides. At first, the atrophy shows in the cartilage, but gradually the bone and soft structures, even to the skin over the joint, undergo the same change. In the early stage there may be an increase of fluid in the joints with a distinct villous synovial process, both of which disappear as the atrophy develops. The disease is a slowly progressive one, the extension going on gradually for many years, and leads to marked crippling. In this type the blood shows but little departure from normal, and shows no special change as the disease develops.

The treatment is partly general, with rest, improved nutrition with forced feeding, tonics, oil,—either cod-liver or olive,—with a wholesome and generous diet in which meat is an important factor, whether red or white being immaterial. The eliminative functions should be kept free and large amounts of water should be taken, with some alkali, such as the phosphate of soda. At times the salicylates are of bene-

fit, but if used it should be remembered that large doses depress, and therefore do harm, while small doses, such as five grains once or twice daily, will give relief if the drug is to exert any influence. Locally the treatment is stimulating, with encouragement of use, stimulating bathing, hot air, massage, and anything that tends to improve the nutrition and combat the essential feature, atrophy. If adhesions have formed, or if deformities have resulted, they should be overcome.

Hypertrophic or *osteo-arthritis*, may be a local or a general process, and is characterized by thickening of the edges of the articular cartilage forming ridges or nodes, which, becoming ossified, interfere with joint motion. As the process extends, the cartilage at the points of pressure is absorbed and the bone near the articulation becomes sclerosed. The essential feature in this type is hypertrophy, and the symptoms are due largely to the presence mechanically of the thickened bone either from the limitation of motion or by pressing upon or narrowing the space occupied by the nerves. The pain may be referred to any portion of the body, depending upon the location of the disease and the nerve pressed upon. The sciatic pain resulting from the nerve root pressure in disease of the lumbar spine is probably the most common of the referred pains. The cause of the disease is not known, but cold, exposure, strains, or injuries seem to be factors of importance.

The treatment consists of fixation or rest for the part affected, to prevent irritation, with only such internal treatment as would tend to improve the body tone, and regulate the eliminative functions. The disease is not usually a progressive one, and with proper treatment subsides, leaving little to show other than the thickened cartilage and new formed bone.

The blood shows no special changes.

Infectious arthritis includes most of the cases of acute, inflammatory, and chronic rheumatism as well as many of the septic processes, and the symptoms may be due to a toxine formed by any of the infectious organisms, or to the presence of the organism itself within the joint. The process may be non-articular or polyarticular, and many or a few of the joints may be affected, but, whether many or few, those which are affected become so, in the majority of cases, within a short time, with little if any further progression as is seen always in the atrophic type. The severity of the case depends upon the organism and the extent of the infection. If the organism itself is present within the joint, the capsule of the joint may be much thickened with resulting disability, as is true with the gonococcus, or there may be marked destruction of tissue with pus formation, if the pneumococcus, the typhoid bacillus, the streptococcus, etc., be present.

The blood is normal in the beginning, but gradually a secondary anæmia develops. The glands are enlarged throughout the body, but whether much or little depends upon the severity of the infection. In these cases the atrophy or hypertrophy seen in the two preceding types is not present.

For treatment, as the condition is practically a septicæmia, the general plan should be to combat this. Tonics, forced feeding, fresh air, with moderate quiet of the affected joint, and such treatment as would tend to lessen the local inflammation. In those cases in which the organisms themselves are present within the joint and show evidence of pus formation or marked capsular thickening, the joint should be opened and flushed out.

The prognosis in this type may be good or bad, depending upon the organism present, and it should always be remembered that the endocardium is not infrequently involved in such processes.

Chronic Gout.—The fifth type is less understood because so much less common, and with our limited knowledge, can probably best be described under the term of chronic gout. In the few cases studied, the essential characteristics are the same, the chief ones being deposits of the urate of soda in the soft structures about the joints with some bone absorption adjacent to the deposits. On first appearance these deposits may resemble or suggest the nodes seen in the hypertrophic form, but instead of being attached to the bone and being firm to pressure they are soft and can be moved about in the soft structures entirely without connection with the bone. Usually only a few of the articulations show such deposits.

Of the bone changes, the shaft of the bone frequently is affected, and in the fingers or toes an entire phalanx may be destroyed. The process involved only a small portion of the bone at a time, gradually extending into the rest of the shaft, so that when first seen the destroyed portion appears with a sharply defined, punched out edge.

The ætiology of these cases is not known, and comparatively little is known in regard to the treatment. It represents a type which apparently must be recognized, but about which much work must be performed before the cases can be treated intelligently.

The Pathological Lesions of the so-called Rheumatoid Diseases.

Dr. Charles F. Painter, of Boston.

In presenting this subject for your consideration I wish at the outset to state that the material forming the basis of this report has not been derived from post-mortem observation, neither has it come from cases so far advanced as to be subject to the criticism that they represent the "end results" of the rheumatoid process, but it has come from cases operated upon, oftentimes principally for the purpose of obtaining fresh tissue from the active stage of the disease and therefore represents acute processes, in so far as any disease may be regarded as acute whose lesions are actively being developed one after another over considerable periods of time. The changes taking place in a rheumatoid joint as a result of the activity of the specific cause of the disease, whatever that cause may be, are just as representative as those taking place in a tuberculous joint. We can usually identify the latter lesions when we see them some months or even years after the process is known to have had its beginnings. The lesions of tuberculosis, however, when the disease is inactive, are oftentimes

extremely difficult to identify. They do sometimes essentially differ from the earlier manifestations and at times undergo changes which mask their distinctive character. This holds true in both diseases in the case of the microscopic and gross pathological appearances. Secondly, I believe that it will be generally accepted that in the two diseases where the pathologist is most frequently called upon to express an opinion as to diagnosis, viz.:—in tuberculosis and cancer, his opinion carries the greatest weight who possesses the most intimate knowledge of those diseases, not only from his understanding of the histological changes brought about in the tissues invaded, but from his familiarity with their method of onset and their clinical history. In passing judgment a conservative man does not rely upon any one group of signs or symptoms; when he does, he frequently has reason to regret his rashness. A great part of the confusion which has existed in the past about this group of diseases has been caused by the fact that the pathologist and the clinician have not worked in harmony; the observations of the one have not been checked by those of the other.

If these premises be accepted, and the material presented in this paper be regarded as representative of a typical period in the advancement of the disease in question I think we are in a position to proceed to the consideration of the subject.

Bearing in mind the clinical classification set forth by the previous speaker, I shall take up first Chronic Villous Arthritis; second, Chronic Atrophic Polyarthritis; third, Chronic Hypertrophic Polyarthritis, and fourth, but less exhaustively, because of the lack of material for its study, Chronic Infectious Polyarthritis. In studying these conditions they will be approached from five points of view,—(1) The histological changes in the periarticular structures of the joints; (2) in the osseous structures; (3) in the fluid aspirated from the joints; (4) from the study of the X-ray pathology, and (5) from the study of the blood and the metabolism of the organic and inorganic salts. As the X-ray has been perfected we are finding in it, in these diseases, as in tuberculosis, one of the best means of investigating the pathology of their lesions.

For the description of chronic villous arthritis the reader is referred to an article on this subject published in the *New York Medical News*, under dates of November 14, 21 and 28, 1903.

Chronic Atrophic Polyarthritis.—As has been stated, we have attempted to select a nomenclature which has some significance based upon the observed coincidence of tissue changes and clinical manifestations, trying to avoid the assumption of meaningless terms for different stages of the same disease.

Chronic atrophic arthritis we believe to be descriptive, in the first two adjectives at least, of an entity; the term arthritis, if it be not too literally construed to mean an inflammation of the joints, will serve our present purposes. That there are some features of the changes in the affected tissues resembling a true inflammation must be admitted, but that these changes can be identified with the specific action of any demonstrable organism, bacillus, or coccus, is certainly unsubstantiated, and we believe our present knowledge does not justify such an assumption.

This disease, though a constitutional one, shows its principal lesions in the joints. What the changes may be in the vital organs during its more active stage cannot be determined. Whether they would show tissue changes similar to those seen in the joints in this stage must be purely a matter of speculation. Necropsies upon patients dying late in the course of the disease have shown no distinctive alterations in the viscera or in the central nervous system. We must be content then, until opportunity offers, to study these tissue changes in the joints themselves, assuming that here is the active seat of the disease, since the clinical manifestations are principally local in the joints, and not constitutional.

Three structures are involved in every joint, viz.:—the capsule, both fibrous and synovial, the cartilages, and the bones. Grossly, the synovial portion of the capsule is invariably much thickened, and it is this thickening combined with the atrophy of neighboring muscle, which is the reflex atrophy seen invariably in joint disease, which causes the swelling of the affected parts. There is very little fluid in these joints as a rule, the swelling being due to the thickening of the synovial capsule and the conversion of this into more or less congested villi. At times one finds some fibrinous flakes within the joint, but this is usually when there is an increase in the amount of synovial fluid. The entire membrane is a good deal congested during the more active stage of the disease, and the hypertrophied villi within the joints are well distended with blood. Along the line which marks the shading off of cartilage into bone, one usually notes the congested character of the synovial membrane, raising it above the level of the neighboring tissue, like the pannus seen in tuberculosis. The cartilage is thinned throughout the entire extent of its surface, loses its glistening whiteness, becomes more or less granular and streaked, and in places shows eroded areas sometimes as large as the old-fashioned three cent piece, usually much smaller. Through these eroded spots one can sometimes see the cancellated bone beneath. The bone itself is also thinned; the intertrabecular spaces are filled with fat, and the usual cellular tissue occupying these spaces has been largely replaced by fat, apparently a degeneration similar to that occurring in the villi of the synovial fringes, giving rise there to the so-called arborescent lipomata. Several other degenerative or metaplasic changes have been noted besides the fatty metaplasia, e. g., to bone and cartilage and also a metaplasia to a tissue resembling lymph glands. The trabeculæ are less in number and smaller in size and do not seem to anastomose as they do in the normal bone. The vessels running in the bone marrow are many of them endarteritic, as they are observed to be in the case of the vessels in the enlarged synovial fringes. There are places in the specimens where there is some round celled infiltration, about the endarteritic vessels usually, but none of the other accompaniments of an active inflammation.

We cannot cut down and remove bone and cartilage as often as we would like in these cases and thus get material for histological study, but in the present perfection of the X-ray we have at our disposal a method of study which is adapted to giving us satisfactory and reliable evidence of what goes on in bone and joint structures in this disease. In relation to tuberculosis, Drs. Bradford, Brown, and Feiss have shown that the X-ray is capable of giving the most accurate information of the situation and extent as well as character of various bone lesions, and this in the early stages of the diseases, not merely after it had made considerable progress. Let us look for a moment at what it is capable of showing of the lesions of atrophic arthritis. The X-rays of the hands, knees, etc., which have been shown present, I think, as characteristic changes and changes of the same general type, as the microscope shows. They reveal the general shrinking of the cartilage from atrophy of this tissue; they show the diminution in density of the bones due to the lack of calcium salts, about which I shall have more to say a little later, and they show the thickening of the capsule and the general villous enlargement of the synovial membrane. In the later stages of the process in those cases where recovery from severe lesions is taking place, they also show some tendency to repair, with a suggestion of bony enlargement. But the cases where there is any liability to confound the atrophic with the hypertrophic processes are extremely rare, and we must remember that atrophy does not go on with absolute symmetry in these joints any more than hypertrophy goes on with absolute symmetry in the joints of chronic hypertrophic arthritis.

In regard to the bacteriology of the fluids obtained by aseptic aspiration our results have been negative. The technique described by Bannatyne has been scrupulously followed in ten cases and no organisms obtained. That organisms may be found in cases whose joints present clinical appearances similar to those of the chronic atrophic arthritis is not doubted, but I believe those cases really belong to the infective group that are to be spoken of later.

Regarding the changes in the blood in these cases it has seemed to me that in comparing the results of the blood examination made by Dr. Erving upon cases of chronic atrophic arthritis with that of the blood in the acute arthritis of rheumatism and other types of infective arthritis, we have a suggestion speaking against the supposed infectious character of the type which we are considering. In acute rheumatisms and other infectious processes where I have seen the records of blood examinations there is a low hæmoglobin content, a leucocytosis, and a slight diminution in the number of reds. In acute rheumatoids or chronic atrophic arthritis the hæmoglobin was high, there was no increase in leucocytes, and in both men and women the red count was appreciably above the normal for the respective sexes. How much weight should be given to this sort of comparative observation is perhaps questionable, but it seems to me legitimate to say that it speaks against any similarity in pathology in these two types of arthritis.

During the past three years we have been carrying on a chemical investigation upon the metabolism of the inorganic salts in this disease. The nitrogenous metabolism has been studied at the same time. This investigation was instituted because of the clinical suggestions that were being forced more and more upon us that the fundamental cause of this disease was not to be ascertained through the channels of pathological research. The results of the series of observations upon atrophic arthritis showed a reversal of the ratio of calcium to magnesium as compared with the normal cases. It also showed that twice as much calcium was eliminated in the urine and feces as was ingested, and inasmuch as the clinical and pathological study of the cases tended to show an atrophy and softening of the bony trabeculæ, and as we know the larger part of the calcium salts of the body are in the bones, our metabolism study seemed to show that the bones are being impoverished through some disturbance in their metabolism. (The full report of this work is to come out shortly in *American Medicine*.)

Two observations were made upon the same patient, the first at a time when the joints were acute, and two years later when they were all quiet, and in this case the amount of calcium excreted at the second observation was equal to her ingesta and the ratio of calcium to magnesium had been restored to normal.

Hypertrophic Arthritis.—The material studied in our investigation of this disease has been obtained chiefly from excisions of the hip in cases of morbus coxae senilis. On gross examination, when the joints affected with this process are opened, one is struck with the relative absence of the infiltration of the capsule seen so constantly in the atrophic arthritis. There is much less of the villous hypertrophy; there is usually not much fluid present unless there has been recent joint strain; the synovia is not much congested; the point where the cartilage shades off into synovial membrane is apt to be congested and one usually notes some elevation of the tissue along this line into a ridge at the points where later one finds osteophytes developing. This is generally noted most conspicuously in the lateral aspects of the femoral condyles in the knee, or if in the hip just at the epiphyseal line and along the superior lip of the acetabulum; if in the phalangeal articulations sometimes in the lateral ligaments themselves. The cartilage has a denser, more ivory-like appearance, and is materially thickened, not only as compared with that in the atrophic type, but as compared with the normal. It has not lost its glistening bright appearance, and does not usually present erosions like those of atrophic arthritis or tuberculous arthritis, or of infective arthritis. In the cases where erosions occur in hypertrophic arthritis, they occur when the function of the joint has been impaired by the overlapping of the hypertrophied bone and cartilage, and are in the nature of decubitus erosions or else represent the dimples left in the cartilage where osteophytes have been chipped off. It is in this type of arthritis that one finds detached pieces of cartilage free in the joint. In places large

sized and isolated spurs of hypertrophied cartilage project directly into the joint and when villous hypertrophy is noted in these cases to any considerable degree it is in the neighborhood of these spurs, as though the traumatism of the spurs caused the synovial membrane to become locally thickened.

It is extremely difficult to prepare this osseous and cartilagenous tissue for histological examination on account of the difficulty of decalcification. The wet specimen (here shown) had been in 20 per cent. HNO_3 for several weeks and frequently changed before it could be cut at all. The bone trabeculae seem very large if you compare them with the trabeculae of the atrophic type; they anastomose normally; take up the stains naturally, and show the usual amount and customary type of intertrabecular cellular tissue, except in those specimens where prolonged decalcification has been necessary, in which case the HNO_3 has eaten out the cellular tissue. There is no undue amount of fat tissue and the vessel walls do not manifest the endarteritic changes seen in the atrophic bone, though the increase in the number of vessels is marked. I have never observed, as some writers claim they have, both the atrophic and the hypertrophic lesions in the same joint, where I have had the opportunity to study the inside of the joint during life, and where the *clinical* symptom-complex revealed the two types unmixed.

The study of these lesions by the X-ray is entirely confirmatory of the observations just made upon them grossly and histologically. The passage of the rays through this sort of bone is much more impeded than in atrophic arthritis and the osseous tissue is much more dense throughout. The cartilage being hypertrophied rather than atrophied, shows a broader line than is seen in the atrophic type between the osseous components of the affected joints. A conspicuous feature of the hypertrophic arthritic lesions as shown by the X-ray, as in life, are the irregular spur-like formations of osteophytes projecting not so much into the joints as overlapping the joints and causing the impairment of function so commonly seen in this type of arthritis. As a result of this restriction in motion and consequent impairment of function, abnormal pressure is brought to bear upon restricted portions of the joints, and it is in these that the cartilage becomes worn away and erosions appear which have caused some observers to maintain that the essential lesions of the atrophic arthritis are found in the hypertrophic form. On the other hand, one sees occasionally a certain amount of hypertrophy in the otherwise markedly atrophic joints, but this is due to the repair process which takes place in atrophic arthritis, and must be distinguished from that of hypertrophic arthritis.

The Blood Examination.—In a study of any disease where there is, even remotely, a suggestion of a bacterial origin, it would be a serious omission to overlook the blood examination. In the study of the pathology of these diseases, we have looked into this matter particularly in the cases of the hypertrophic and atrophic types.

I will summarize the results obtained by Dr. W. G. Erving, who made careful observations in our clinic upon twenty cases of atrophic and twenty cases of hypertrophic arthritis, being careful to select patients where there were one or more joints in the active stage of the disease, so far as clinical symptoms would permit one to judge.

Dr. Erving studied the blood in forty cases which he groups as rheumatoid arthritis and osteo-arthritis and gives a summary of the blood conditions as regards the red blood cells, the hæmoglobin, the leucocytes, and the differential count of the last. In both groups the count of the red blood cells ranged slightly higher than normal and the hæmoglobin percentage was close to the 100 mark (the Tallquist scale was used). This was true also of the pale, sallow, poorly-nourished sufferers from a more or less general rheumatoid arthritis. There was present in most of the cases a slight leucocytosis, but this seemed to bear no relation to the severity of the symptoms or to the duration of the disease, and the differential count was almost normal, some cases showing a relative decrease of the polymorphonuclear cells and a relative increase in the mononuclear elements.

In short, the condition of the blood is not such as would be expected in diseases of such a general wasting nature. No abnormal elements such as microcytes, macrocytes, nucleated reds, or other signs of hæmic degeneration were found.

The same series of observations have been made since the appearance of this paper on twenty more cases with similar results. There are high leucocyte counts and secondary anæmia in certain of the polyarticular arthritic cases, but they belong to the infectious class.

Infectious Arthritis.—This type undoubtedly represents the largest group of the three here under discussion. The lesions so far as they can be studied are alike in their main characteristics, and I believe will be shown to resemble each other as closely as their clinical symptoms will when they are more thoroughly understood. I have had very little opportunity to study this type of arthritis histologically. The few cases I have seen have been apparently gonococcal infections. In these joints there is much more likely to be a considerable excess of more or less turbid synovial fluid when they are opened during the acute stage; the synovial and fibrous capsule is considerably and *uniformly* thickened, sometimes markedly thickened. There does not commonly result as much villous or arborescent hypertrophy as in atrophic arthritis, but the general thickening of the capsule and the adhesion of the synovial to the fibrous capsule is very marked, in this respect differing from the two previous types. This infiltration is with dense masses of round cells, and many more leucocytes than are seen in atrophic or hypertrophic arthritis. The cartilage is not generally thinned, but is at times eroded; there is no osteophytic enlargement; there are frequently great numbers of firm adhesions between the layers of the synovial membrane so that a good part of the synovial pouch becomes obliterated by these adhesions, which later becomes extremely firm and fibrous, resulting in a practical ankylosis. In this, as in the case of hypertrophic arthritis, the erosions

only occur after a practical ankylosis from adhesions or from actual necrosis.

An X-ray in these cases shows an absence of any cartilaginous or osseous change. There are few erosions and no osteophytic formations. The capsule, when the negative is properly developed, will show decidedly the thickening of this structure. The presence of the infiltration of the capsule and the effusions accompanying these lesions obscure the X-ray picture very much and cause a peculiar blurred appearance in these cases, which is more or less characteristic. The blood count, certainly in the majority of cases, will show a greater or lesser leucocytosis, a lowered percentage of hæmoglobin, and a greater or lesser degree of anæmia, thus pretty clearly separating this group of arthritis from those studied by Erving, and heretofore referred to.

To this group belong the arthritides secondary to the acute infectious diseases and tonsillitis; those due to the pneumococcus and gonococcus; Still's disease, pyæmia, and septicæmia; and probably the so-called acute articular rheumatism. The blood in all these conditions uniformly shows a different picture from that in atrophic or hypertrophic arthritis. No metabolism work has as yet been carried out upon patients suffering from this type, unless, perchance, one case in our series represented such a condition.

Discussion.

Dr. McCrae.—We are very much indebted to Drs. Goldthwait and Painter for the very interesting talk they have given us. The whole question of arthritis is in such a mixed condition that one hesitates very much before discussing it. We have grouped together a number of conditions which perhaps have one common feature, namely, arthritis.

I think in this clinic we recognize several definite groups of arthritis cases. First are those associated with a definite organism, such as the arthritis associated with a gonococcus or with a pneumococcus. Then there is the large group of cases which we term acute articular rheumatism, and it seems likely that before long we may be able to recognize these cases definitely, or in other words, that some distinct organism will be found as the cause. Then comes a group of cases which we put under the general heading of arthritis deformans. One of the first points to decide is whether under this heading we may not have two distinct diseases. As has been shown to-night, there are two distinct conditions shown anatomically, namely, atrophic and hypertrophic. As I understand Dr. Goldthwait, he is rather inclined to separate these. The opinion in this clinic at present is rather to consider the two conditions as varying manifestations of the same disease. Upon the question of the etiology of this large group we are very much at sea. I think here we have been impressed with the infective nature of many of the cases. Dr. Goldthwait has referred to the condition known as "Still's disease." That we regard as merely the form of arthritis deformans occurring in early childhood. I think we have seen all grades of like cases from childhood up to adult life. The glandular and splenic enlargement become less marked in the older patients. The whole picture in those patients suggests an infection. As to whether this is due to a specific organism or to the toxines of various organisms, I do not think we can say.

In conclusion, if I may be allowed to say before their faces what I have often said in their absence, I feel that we owe them a great deal for the stimulus they have given to the proper study of this class of disease.

Dr. Finney.—While Dr. Goldthwait was speaking I could, from his description, recognize some of these joint affections as conditions that I had met with in my own experience and I can recall now a number of illustrations representing just the features he has described, and I may add that in the treatment of these cases I have many times been at a loss to know just what to do.

In several of them we attempted, as Dr. Goldthwait has suggested, to excise the villi and remove the lipomatous growth, but always in a half-hearted sort of way and never with anything like the thoroughness he has suggested. I shall now feel encouraged to attack these cases with more assurance and with the expectation of more satisfactory results than I have secured in the past.

I would like to ask Dr. Goldthwait what were the functional results in the cases where such extensive excision of the villous growths has been practiced, as in the case of the first specimen passed around. I think that much of the ultimate success must rest upon the painstaking care that one exercises in the after-management of these cases, as regards massage, active and passive motion, etc. It requires much patience to follow these patients for months and years, but any one who knows Dr. Goldthwait can appreciate the amount of care and attention he must have given to this work.

I had thought heretofore that these two forms that Dr. Goldthwait has described, the atrophic and the hypertrophic, were but different manifestations of the same pathological condition. It would seem, however, that Dr. Goldthwait and Dr. Painter have made out a very strong case in favor of the idea that they represent different pathological conditions.

Dr. Bloodgood.—I wish to add my thanks for these admirable papers. It is a credit to orthopedic surgery to enter this new field and to investigate a series of chronic joint lesions which the medical clinician has acknowledged his inability to aid, and in which as yet the general surgeon has shown but little interest. Contributions of this character have an excellent influence, because they aid in the earlier recognition of similar lesions. In this earlier period the possibilities of accomplishing more satisfactory results are greatly increased.

My own experience with joint lesions brings out the fact that the clinical picture and the pathological changes vary to such an extent at different stages of the disease that they are very likely to be considered, both clinically and pathologically, as different kinds of arthritis.

The most important fact in the treatment of both acute and chronic joint lesions is that treatment should be instituted at

a period in the disease in which the pathological lesion has not extended beyond the possibility of a return to normal. The ultimate tendency in all forms of arthritis is to the destruction and replacement by fibrous tissue of the essential tissues of the joint, the synovial membrane and the articular cartilage. When this destruction has been accomplished there is no hope to restore the function of the joint. The possibilities of early recognition and cure are greatest in infectious arthritis and tuberculosis. In infectious arthritis it is most important to aspirate the joint effusion at once. The demonstration by cover-slips or culture of the presence of bacteria is a positive indication—or better, a command—to open and to wash out the joint cavity at once. This treatment has been followed in Dr. Halsted's clinic for years. In cases admitted to the clinic in the early days before the acute inflammation of the synovial membrane has reached an irreparable stage, the results of arthrotomy and irrigation have uniformly been most satisfactory, and joint function has been perfectly restored. I have discussed this treatment and the results in detail in the December, 1903, number of *Progressive Medicine*.

DR. GOLDTHWAIT.—It has been claimed by some observers that the atrophic form of this disease is the acute stage, and the hypertrophic, the chronic stage of the same disease, but this does not seem to be borne out by facts.

Genito-urinary surgeons tell me that the majority of gonorrheal cases are of a slight character and get well in a few days, and with these there is only a slight joint effusion, representing probably a toxæmia. It is only in a few cases that there is the more active process which goes on to infiltration of the capsule, due to the presence of the organism in the joint with a long tedious illness, leading usually to serious impairment of joint function. In the treatment of such cases we should not open any joint until there is a distinct reason for it, but if after two or three weeks the process is still active, it is well to open the joint and flush it out. If the diagnosis is not clear in any case, after waiting a reasonable time and resorting to all the means of diagnosis we have, tuberculin, X-rays, etc., I feel that in many cases it is wise to open the joint for diagnostic purposes.

I agree with Dr. McCrae that although we do not know the organism associated with many of the cases of acute articular rheumatism, the picture is so clearly that of an infection that it is perfectly proper to call them infectious arthritis. The essential characteristics are the same and whether you have pus formation or not depends upon the nature of the micro-organism present in any particular case.

MARCH 7, 1904.

The meeting was called to order by the President, Dr. Futcher.

Exhibition of Medical Cases. DR. MCCRAE.

The patient I wish to show the Society to-night is interesting, especially in view of the recent communication presented here by Drs. Goldthwait and Painter, of Boston. You will remember that, in speaking of the rheumatoid diseases, they used the term "infective arthritis," and included under this term a number of cases which we have usually called arthritis deformans.

This patient illustrates one of the most interesting divisions of arthritis deformans. There are many debatable points in regard to the etiology and to the grouping of cases of that disease. One must remember that in this disease we have previously too often considered only the late manifestations. We have wrongly regarded it as a disease of advanced life, with marked degenerative changes, forgetting that in its earlier stages it is more or less of an inflammatory nature.

The patient is a male, aged 20 years, who complains of joint trouble. He has always been strong and healthy. There is no history nor any evidence of gonorrhea. His illness began about three months ago in the left shoulder. There was severe pain, swelling and tenderness. Soon both knees and one ankle were involved. The small joints have escaped completely. He has had some fever, although this has never been high. The condition is one of acute polyarthritis.

Examination shows an unusually healthy-looking young man. The joints now troubling him are the right shoulder, the right knee and one ankle. There is a certain amount of swelling of these, some restriction of motion, more or less boggy resistance and definite creaking. There is a general glandular enlargement and an enlarged spleen. His reflexes are increased. The blood count is normal, there is no leucocytosis, the urine is clear and his temperature normal.

Such a condition speaks for an infective process or the results of such a process. The case is of special interest, I think, when considered in association with that group of cases which has previously been termed Still's disease. Dr. Still described his cases as occurring in children, but here we have practically the same condition, only less marked, both as to the splenic and glandular enlargements. The opinion has been gaining ground that Still's disease is not a definite entity but is merely an arthritis deformans occurring in childhood. I think it is a reasonable view to take that these cases are all manifestations of the same disease.

The future course of these cases is variable. A certain number recover very well. This patient may in a few months be, to all intents and purposes, a well man, but he may have recurring attacks or there may be more or less marked changes left in his joints. If we regard these cases as an infection of some kind, an interesting point arises as to its nature. Concerning this there are two views, one that it is a specific infection with a definite organism and another that it probably follows infection by any one of a number of different organisms such as those of gonorrhea, influenza, mumps or measles. That is a matter yet to be cleared up, but we do know this, that any subsequent infection will alter the conditions very markedly. If this patient recovers fairly well and six months later contracts influenza or some other infection, he will probably have a recurring attack of this general trouble.

The question of treatment means first getting the patient into good condition. As to the joints, I am personally rather inclined to advise the opening of the most affected ones. The

X-ray plates in this case show that as yet there is no erosion of the joint surfaces. That supports the advisability of operating, for we know that if left alone the joint surfaces suffer sooner or later, and we have the impaired motion of the later stages.

Exhibition of Medical Cases. DR. COLE.

Dr. Osler has asked me to present this case of probable tuberculosis of the parotid gland to the Society to-night. It is interesting, first, from the standpoint of diagnosis; second, if it be tuberculosis of the parotid, on account of the rarity of this condition; and thirdly, in connection with the question of the mode of infection in parotitis.

The history briefly is as follows: The patient, a colored man, aged 34, was admitted complaining of "swelling in front of the ears." There is no history of tuberculosis in the family and the past history of the patient is unimportant, except in two particulars. First, there is a history of lues, the primary sore occurring about eight years ago, and second, the patient was admitted to this hospital five years ago with tuberculous glands of the neck, which were removed. Since that time he has been quite well and has been regularly at work up to about nine weeks ago, when he was suddenly seized with a sharp pain in the left side of the chest. He had to stop work and for six weeks was confined to bed most of the time. The history the patient gives of this attack makes it probable that he was suffering from a pleurisy and probably not an acute lobar pneumonia. For the past three weeks there has been no cough or fever. About 10 days after the onset of the illness noted, the patient accidentally noticed an elevation in front of each ear which rapidly grew to the present size. These tumors have never caused him any pain or inconvenience and he is only conscious of their presence when he feels them or observes them in the mirror. There has been no pain over the cheeks, no increased flow of saliva.

You now see a moderately healthy looking man with a large scar on each side of the neck; these are remains of the old operation wound. Just in front of the left ear is a swelling about the size of a walnut which occupies the parotid region and on palpation is found to be rather soft and fluctuant. In a similar position on the right side is a smaller elevation, about the size of a hickory nut, which is quite firm and hard. Yesterday a needle was inserted into the fluctuating tumor on the left side and about 2 cc. of a dirty yellow fluid withdrawn. This was found to contain mainly necrotic caseous material with a few leucocytes. A very careful search for tubercle bacilli has been made, but none have been found. Cultures made from this fluid are negative. A portion has been injected into a guinea-pig, and we shall later know the results of this test.

As to the diagnosis, it is pretty evident that an acute infection and new growth may be excluded. With his history, the possibility of syphilis must be considered, but the early breaking down of the tumor on the left side renders this improbable. In view of the fact that he has had tuberculous lymphatic glands in his neck, that he has just been suffering from a pleurisy, the remains of which give rise at present to signs of thickened pleura, it is more than probable that the condition is one of tuberculosis. The patient will be transferred to the surgical side for excision of these masses, and the histological examination of them, with the results of our guinea-pig experiment, will make the diagnosis certain.

Tuberculosis of the parotid gland is an exceedingly rare condition and a very few cases have been reported. The condition has been quite fully considered in an inaugural dissertation for last year by Ludwig Borchardt, of Freiburg. He was able to collect only 10 cases in the literature besides the one case reported by himself. I have also found a further case mentioned by Köenig in his text-book on surgery.

One of the most interesting questions in connection with this subject is in regard to the cause of the relative immunity of the salivary glands to this infection, to which man and most of his organs are so susceptible. Of course a full discussion of this point would involve a consideration of one of the most interesting and fundamental questions in the pathology of infections, that of the relative susceptibility and immunity of organs to given infections. It may be mentioned, however, that Borchardt quotes some interesting experimental work of Paoli with reference to a possible antagonism of the saliva to the growth of the tubercle bacilli. He was unable to demonstrate any such antagonistic action, however, either of the unchanged saliva or that freed from the mouth bacteria by heat.

A further question is as to whether in these case of tuberculosis of the parotid the condition is a true infection of the parotid tissue or of the lymphatic tissue lying within the parotid substance. According to Poirer, Cuneo and Delamere (The Lymphatics, translation by Leaf, 1904), lymphatic glands in considerable numbers are scattered throughout the parotid space. These are of variable size, from those easily recognized by the eye to those microscopical in size, "besides lymphoid masses of variable shapes and sizes which surround the acini." The histological study of the specimen in Borchardt's case seemed to show that the condition was one of "tuberculosis arising in the lymphatic apparatus of the parotid which led to secondary atrophy of the parenchyma of the gland, which did not appear to share actively in the inflammatory process." Some of the other cases also appear to have been analagous, though others were apparently true infections of the parotid tissue.

We will probably find that in our case the infection is a lymphatic one, as the previous history makes it probable that the process is simply an extension upward of infection of the lymphatic glands of the neck.

So long as there is so much doubt as to the mode of infection in the acute parotitidin we cannot hope for a clear knowledge in regard to this with these very rare chronic forms. Virchow's view as to the infection arising from the mouth through Steno's duct is probably true in a large proportion of the cases, though in some of the acute diseases at

least the infection must be a hæmatogenous one. Otherwise how can we explain the comparative frequency of parotitis in typhoid and its rarity in pneumonia when in the latter disease the mouth must contain enormous numbers of the virulent organisms? The whole question is an exceedingly interesting one and well worth further experimental study.

An Experimental Study of the Eosinophile Leucocytes during infection with an Animal Parasite (Trichina spiralis). DR. OPIE.

(See BULLETIN for March, 1904, page 71.)

The Origin (chemical) of Leucocytes in Leukemia. DR. EMIL SCHMOLL.

(See page 238).

Myomectomy in its Relation to Pregnancy. DR. KELLY.

Dr. Kelly stated that formerly in all cases of myoma panhysterectomy or supravaginal hystero-myomectomy was done, but with improvement in technique myomectomy has been more commonly practiced. Two hundred and thirty-one such operations have been done at the Johns Hopkins Hospital, with six deaths. The following are the reasons for the procedure: It removes the disease without the uterus; it avoids menstrual disturbance and an artificial menopause; it allows conception; it does not cause the mental distress which accompanies removel of the uterus. Of 140 subjects reviewed by Dr. Kelly from his own work, four have conceived. The patients presented various types and sizes of myoma. Two of them have borne full-term children, one miscarried, and one is now pregnant. Schauta, Wurder and Olshausen have reported cases of conception following myomectomy, but there is no series which shows quite this number of successes.

DISCUSSION.

DR. NOBLE.—I had no idea of talking about myomectomy when I came over here this evening. The subject is one, however, in which in common with most gynecologists I have been interested, though not in exactly the same way that Dr. Kelly has. I began doing myomectomy early and believe it to be a very valuable operation; but I was never enthusiastic about extending the indications for the operation and so the number I have done has been relatively small. We had a discussion on fibroid tumors in Philadelphia within the past month and consequently I remember my own statistics. I have done 36 vaginal myomectomies and about 35 by the abdominal route. The indications that I have always laid down are, first, that the woman should not be too old. It always seemed useless to attempt it with a woman who was probably too old to bear children, for it is a more dangerous operation than hysterectomy. I have had no deaths in the abdominal cases, but in the vaginal myomectomies quite a number of the tumors were sloughing and there was sepsis present at the time of operation. Two or three patients died. If the woman is over 35, the indications would have to be very strong from the woman's standpoint for me to decide on this operation. Again, if there were many tumors I would not feel that it was a wise operation, and therefore I think four is the largest number I have ever removed from one uterus. Another reason that influences me is that if there are many fibroids of an appreciable size the chances are that there are others which are not appreciable and these may be left.

For those reasons, and being a conservative man, although some people say I am not conservative, I have not extended the indications for the operation. I have not worked up the question of pregnancy following these operations, but I recall the fact that two of the women I have operated upon have since borne children. From that standpoint, the way I feel about the matter is that if the woman is not above 35, has had no children and is desirous of having a child, and there are not many fibroids present, and she and the husband, knowing the greater risks of the operation, are willing to take the risk, I should operate. But if those indications are not met, I prefer to do hysterectomy.

Observations on the Study of the Sub-Clavian Artery in Man. DR. BEAN. (See Bulletin for June, 1904, page 203.)

APRIL 18, 1904.

The meeting was called to order by the President, Dr. Futcher.

On the Surgical Importance of the Visceral Crises in the Erythema Group. DR. OSLER.

For the benefit of the students I will say a few words on the classification of colic, and I will refer you to a good paper by Dr. Musser on the subject which appeared a few weeks ago in *American Medicine*.

In the first place, there is an interesting group of cases of colic associated with the intoxications, as, for example, in lead poisoning, much less frequently uræmia, and less frequently still with morphia. It is not usually recognized that in these latter intoxications there may be recurring attacks of colic. In morphia habitues when the morphia is being gradually withdrawn colic may be of a most severe character.

Secondly, a large class of cases of abdominal pain associated with functional and organic disturbances of the nervous system; hysteria is sometimes associated with pain simulating peritonitis or appendicitis. An interesting series of such cases was reported by Dr. Bristow. Perhaps the most typical form in this group is the well-known crises seen in tabes.

Thirdly, the abdominal pain associated with disease of the lung or pleura. The initial abdominal pain in these diseases may simulate appendicitis.

Fourthly, a group associated with certain cardiac conditions. In pericarditis the pain may be referred entirely to the epigastrium. In angina pectoris, the recurrent attacks of pain may be altogether below the ensiform cartilage.

Fifthly, there is a very large group in which the pain is due to lesion of one of the abdominal organs, the peritoneum, the stomach and the intestines of course heading the list; the liver, the kidneys, the pancreas not so frequently; the spleen least frequently of all.

Lastly, you have the abdominal pain associated with pelvic disease, a common form and very difficult to recognize.

This is a convenient classification of the conditions in which we meet with severe abdominal pain. I wish to call your attention to-night to a very striking class of cases in which the abdominal pain is a feature of such dominance that the patients may be admitted to the surgical wards and a laparotomy performed for a functional colic due to angio-neurotic œdema or puncture of the intestinal wall.

Case 1.—A young girl, aged 17, a patient of Dr. Fox's, seen by Dr. McCrae on the first of December last. I will read his note (reading). She was found in bed in a curious attitude seemingly in severe pain of an unusual character. Examination of the abdomen was negative; she was not tender and the hand could be passed deeply in all directions. The knee joints were tender and red. She had received large doses of morphia, which only allayed the pain for a short time. The diagnosis of abdominal pain with arthritis was made and she was brought into the hospital. Many of you remember that she was a healthy-looking girl with a marked arthritis. There was a slight amount of albumen in the urine and numerous tube casts. On examining the abdomen we noted the mark of an incision in the upper right quadrant. She had been healthy as a child and her present illness had begun six months previously with recurring attacks of pain in the epigastrium and in the left side. These came on every week or two and lasted for several days. The pain had no relation to the food taken and was not relieved by any special position. In August the pains recurred with such severity that the diagnosis of intra-abdominal trouble was made and she was taken to the City Hospital and an operation performed, but nothing of any importance was found. The condition was thought to be gall-stones.

After a brief visit here in the hospital she went home feeling fairly well, but returned in a short time with a history of recurring pain and for the first time then had bleeding from the nose. At this time we found an erythematous eruption on the left flank. This case belongs to a remarkable group in which, with a skin affection, purpura, angio-neurotic œdema or erythema there are attacks of colic.

One of my first cases was a boy with the most severe attacks of pain, during which he would almost go into convulsions. I had watched him for some time, but on one occasion when he had these attacks another physician was sent for who knew nothing about his history and who made, very naturally, the diagnosis of renal colic. The mother was requested to take him to a surgeon, but fortunately she came to see me first, and, as subsequent results showed, there was no occasion for an operation. This boy had skin lesions of three different types: first, a distinct erythema, then marked angio-neurotic œdema, and finally purpura.

A second case, No. 20 on the list which I have published, was a boy, aged 7, admitted to the surgical side first for appendicitis. There he was found to have purpuric spots on the body and was transferred to the medical side. He had had these attacks of skin lesion associated with colic for several years. To a third case Dr. Hamburger might refer if he were here. A young woman who had many attacks of nausea with vomiting, with tenderness over the abdomen; an operation was performed for appendicitis but the appendix was found to be normal. Following the operation angio-neurotic œdema appeared on the face and she has had several similar attacks since.

In the first number of the new *Journal on Children's Diseases*, published in England, there are three cases in which operation has been performed and in which hemorrhagic infiltration and œdema were found.

Briefly, the cases may be grouped into, first, those in which the colic occurs in connection with a pure angio-neurotic œdema—Quincke's disease. They are not uncommon, as angio-neurotic œdema is not a rare disease and it may occur in several members of a family. I understand that the case of Dr. Hamburger's to which I referred belongs to a New Jersey family whose history I have reported and in which the disease was present in six generations. The original case in the family was under the care of Benjamin Rush, and in two instances death resulted from œdema of the glottis.

Secondly, there are cases in which the skin lesion is simply an urticaria, and as that is such a common affair it is possible that many of these cases in which the pain associated with it is supposed to be colic from indigestion may be really a part of the nervous affection. In a third class there is arthritis associated with the erythema or purpura and colic, the group which Henoch described and the form known by his name.

Fourthly, there are the cases in which the lesions are those of erythema multiform with or without œdema and most frequently with more or less redness and purpura. Interestingly enough, as in several of my cases, these different lesions have been present in the same patient in different attacks. In the first case I reported the boy had angio-neurotic œdema in one attack, ordinary erythema in another, and purpura in another attack, showing that the skin lesion is a variable affair in the disease.

Finally, there is the remarkable group of cases, really the most difficult to recognize, in which there is only recurring colic and nothing else. If you look over the list of 29 cases I have reported you will see that in a number of those cases colic recurred for years and years before any skin lesion appeared.

The condition is one of very great interest and I bring it before you because of its surgical relations, and it certainly has to be thought of seriously before performing a laparotomy for a doubtful abdominal colic.

Discussion.

Dr. A. D. Atkinson.—Within the past three months I have seen two cases which probably belong to this class that Dr. Osler has described. The first was a girl 18 years of age who had these recurrent attacks of abdominal crises at short intervals and without any relation to any food she had taken.

I saw her during one of the attacks and was struck by the peculiar attitudes she struck in writhing during her agony. The next morning she was covered with the typical erythema, which disappeared within three or four hours.

The second case is especially interesting to me, in so much as an attack of this nature followed the injection of 1500 units of diphtheria antitoxine. The attack came on eight days after the administration, the first symptoms being violent epigastric pains, followed in a few hours by a general urticaria associated with erythema. There was well-marked œdema of both eyelids, a rise of temperature to 103 F., which subsided with the amelioration of symptoms. The duration of the attack was about 20 hours. The various sequelæ which often follow the administration of drugs, like quinine, etc., together with diphtheria antitoxine, form a group of cases that are similar in many respects to those mentioned to-night.

DR. MCCRAE.—There is one point mentioned by Dr. Fox, namely, the association of constipation with the pain, that I wish to speak of. We have had a great deal of difficulty in moving the bowels of these patients and as soon as we succeeded the pain ceased. It may be that free purgation influences the condition and not that the purgation begins only when the pain is controlled. It is an interesting point in regard to the question of treatment. Certainly there is no doubt about the difficulty of purging these patients.

Immunization of Bacillus Dysenteriae by Growth in Agglutinating Serum. DRS. MARSHALL and KNOX.

MAY 2, 1904.

The meeting was called to order at 8 P. M., with Dr. Futcher, President, in the chair.

The Treatment of Delirium Tremens and Allied Conditions. DR. ALEXANDER LAMBERT, New York. [To appear in a future number.]

DISCUSSION.

DR. WELCH.—Dr. Lambert is to be congratulated upon the valuable use which he has made of the unequalled opportunities for the study of alcoholism in Bellevue Hospital. He has referred to the attempts which have been made to approach this subject from the experimental side. Probably the most extensive and prolonged series of experiments upon the pathological effects of alcohol are those which were conducted here in Baltimore by Dr. Friedenwald in behalf of the Committee of Fifty, the main results of which have been published in the two volumes of the report of the Physiological Sub-committee. Like most other experimenters we were unable to produce experimentally the most characteristic, although not the most common, of the morbid lesions of alcoholism, namely cirrhosis of the liver. This negative result cannot be attributed to the short duration of the experiments or to the small quantity of alcohol consumed. It speaks in favor of the view that alcohol acts indirectly in the causation of cirrhosis, the lesion of the liver not being referable to the immediate and direct toxic action of this agent upon this organ.

Dr. Friedenwald noted extraordinary individual variations in the susceptibility to alcohol on the part of rabbits. Whereas certain animals succumbed quickly to repeated daily intoxicating doses of alcohol, others could be kept alive for at least four years under these circumstances without presenting serious anatomical changes.

The most common lesion which was produced experimentally was a fatty metamorphosis of the cells of the liver, the heart muscle and the kidneys. This lesion quickly disappeared after stopping the alcohol. I am not inclined to attach as much clinical importance to the occurrence of fatty degeneration of the cardiac muscle as Dr. Lambert seems to do. This condition cannot be brought into definite relation with the symptoms which it was formerly customary to assign to it. Several years ago in my studies of the general pathology of fever I demonstrated that high degrees of fatty degeneration of the heart muscle could be produced experimentally in rabbits without apparent serious impairment of the force and functional activity of the heart. Of course there may occur such extreme degrees of fatty degeneration of the heart-muscle that it must be supposed that the function of the muscle is seriously injured, but these are relatively infrequent cases. It is now known that most of the symptoms which were formerly attributed to fatty degeneration of the heart are the result of disease of the coronary arteries or of some form of myocarditis, and we also know that a very painstaking examination may be required to reveal some of the significant myocardial lesions. We must, however, admit that there may occur serious functional disturbances of the force and action of the cardiac muscles without definite pathological changes of the heart which we can demonstrate. In these cases there may or may not be fatty degeneration of the muscle, and, as it well known, this degeneration often enough occurs without any symptoms referable to the heart. Of course fatty overgrowth is a quite different condition from so-called fatty degeneration of the heart, and may be a serious affection in alcoholics, especially in beer-drinkers.

Inasmuch as the special poisonous action of alcohol is primarily upon the higher nervous centers, the morbid changes of the nervous system in alcoholism are of especial interest. We should distinguish between those pathological lesions of the brain, such as thickening, opacity and adhesions of the membranes, chronic pachymeningitis, œdema of the brain and meninges, granular ependymitis, atheromatous arteries, etc., which are common in chronic alcoholism, but which are not responsible for the destructive cerebral symptoms of alcoholic intoxication, and those more delicate changes of the nerve-cells and their processes revealed by the Golgi, Marchi and other refined methods. These latter changes can be produced experimentally, as was shown in Friedenwald's experiments, but, as is well known, it is very difficult at present to utilize these findings in explaining the alcoholic psychoses.

One of the most interesting outcomes of recent investigations has been to correlate the various distinctive alcoholic diseases of the brain, the spinal cord and the peripheral nerves on the basis of the neurone doctrine, the underlying condition being a toxæmia induced by alcoholic excess and manifested now in one part of the neurone system and now in another part, it may be in the form of a peripheral neuritis, or of delirium tremens, or of Korsakow's psychosis, or of acute hallucinatory mania, or of alcoholic epilepsy.

DR. PATON.—Dr. Lambert certainly deserves a great deal of credit for this excellent work. He has brought up a number of interesting points, some of which are still the subject of controversy. First, as regards the matter of prognosis and treatment: it is believed that the cases having simple visual or haptic hallucinations generally recover. If auditory hallucinations occur the case is believed to be of a more severe type. As soon as ideas of reference develop the course will probably be a protracted one and marked disturbances in the organic sensibility do not as a rule indicate a favorable outcome. The ordinary case of delirium tremens in certain ways resembles a typical case of mania. Every idea that crops up in the patient's mind is of equal value with the one that precedes it, so that there is a leveling off of ideas.

I should like to ask the doctor if he has had any experience with the prolonged bath in these cases?

DR. LAMBERT.—In taking up the remarks that have been made, those of Dr. Welch concerning the fatty degeneration are of considerable interest. What first led me to pay attention to the condition of the heart muscle was the large number of young women and men who dropped dead suddenly and where the post mortem showed no reason for the death except the drinking. I recall the case of one man, a young man of twenty-one or two, who had only been drinking that morning. He dropped dead on walking across the ward. I have never seen a more normal set of organs than were found in that man. Working in the morgue where all the coroners make their autopsies, we puzzled over the many young women especially, brought up from the Bowery, who had walked out of a saloon and dropped dead in front of it. These cases invariably have fatty degeneration of the heart muscle, and usually that is the only lesion to be found. That a person can get over this condition I know very well from clinical observation. On stopping the alcohol they recover, and the ability to climb hills, etc., soon returns. I have seen many autopsies where no one could tell the cause of death, and yet it seemed to be due to sudden cardiac failure. I know that unless the heart is stimulated in delirium tremens, and careful attention paid to the cardiac and circulatory system, you will lose a larger percentage of cases than is so otherwise.

Dr. Paton's question about the different hallucinations is very hard to answer. As to the continued baths, I have not tried them. We have so many patients that it is impossible. We have found the sprinkle baths, however, very necessary in the summer. As to the hallucinations, I have not gone into that here. I have some three hundred accurately recorded kinds. An interesting point is the manner in which the hallucinations accord with the occupations of the patients. One, for instance, complained that he was being crowded by the elephants. On asking him if he was a circus man, we ascertained that he was a keeper of the elephants in a circus. Another, who was a vegetable carrier, has his vision filled with blue potatoes. The primary colors predominate in these hallucinations, and usually blue seems to predominate over the others. With drivers of horses the hallucination that the horses are backing with him is believed to be a very bad sign. There is no doubt that some individuals have a very marked tolerance for alcohol, in their nervous systems and in the other parts of the organism.

As to Dr. Thayer's question about the use of ergot, I have used it in acute diseases, in typhoid and in pneumonia. My death rate has been lower in pneumonia with its use than ever before, the difference being about 10 per cent. When I stopped ergot the death rate rose about 10 per cent. It is a drug that I took up with much skepticism and for which I have come to have a great deal of respect.

MAY 16, 1904.

Meeting called to order at 8 P. M., with Dr. Futcher in the chair.

The Blood in Pregnancy. W. L. THOMPSON.

(See June BULLETIN, page 205.)

DISCUSSION.

DR. EMERSON.—Mr. Thompson is to be congratulated on this new piece of blood work. What we need is a few cases well studied rather than a great many with less thorough observation. The results obtained in this investigation are certainly very interesting, especially that concerning specific gravity, because that has not been so well worked out and because the curve for that is more regular. That is the most interesting part of the paper and I congratulate him on his successful work.

The Pathology and Treatment of Benign Tumors of Bone with Cyst Formation. DR. HALSTED.

Dr. Halsted exhibited a child, a native of the United States, aged 7 years, who was admitted to the Johns Hopkins Hospital on January 18, 1904, with the following history: He had been a healthy child until June, 1899, when he fractured his left thigh just below the trochanter by a fall. He was placed in bed and a long lateral splint was applied for three weeks. When the splint was removed, a swelling was apparent which gradually increased. When he began to walk without crutches, he walked with a limp and had occasional spells of weakness when he could not walk at all. Ten days before admission to the hospital he injured the leg again and was not able to walk upon it at the time of his admission. There was a marked swelling at the junction of the middle and upper third of the thigh extending into the trochanter. The diseased thigh was from 1 to 2.5 cm. greater in circumfer-

ence than the opposite thigh and Bryant's line was 1 cm. shorter on the injured side. There were no crepitus, no point of false motion, and little tenderness over the tumor.

By means of the skiagraph a diagnosis of a benign tumor of bone with a cyst formation was made. After chiseling out a piece of bone, a small cyst containing a brownish fluid was entered. Upon further exploration a mass of new growth was found occupying the medullary canal. This was shelled out down to a point well below the disease. The bone was then cut through and the head of the femur was enucleated but the limb was not amputated. The patient made a good recovery and could walk in five or six weeks. A skiagraph made several weeks after the operation shows that the bone is being reproduced and a perceptible increase in the amount of bone in the region occupied by the cyst.

Pulmonary Distomatosis in Man (Presented by Dr. Emerson). DR. C. WARDELL STILES. (Lantern Slides and Microscopic Exhibit.)

Dr. Stiles asked me to express to this Society his regret that he cannot in person present this very interesting and important case. I am happy that he has kindly authorized me to show the specimen, and take this opportunity to express our appreciation that we may study this rare case. It is the sputum of a case of pulmonary distomatosis, a case of Dr. McKenzie, of Portland, Oregon, and the first to be discovered in man in America.

Dr. Stiles also sends this portion of the lung of an infected hog, which shows the adult worms, and some lantern slides. The disease has been found in several animals in this country, and, so far as can be determined, it is in all cases the same parasite.

The disease is very common in some countries, especially in some parts of China, Japan and Korea. It is said that some entire villages are infected, and the inhabitants of one village will have nothing to do with those of an infected place. The guess of a native was that about fifteen per cent of his acquaintances were infected. This is a case imported from Japan.

The only symptom is hemoptosis (unless the brain be involved, in which case Jacksonian epilepsy); at first only a few drops of blood, then more profuse and more frequent until the patient dies from anemia. In the periods between these the sputum is of a rusty color, and not due as in pneumonia to changes in the hæmoglobin, but to the presence of these eggs themselves. In this connection I should emphasize the importance of examining fresh specimens of sputum. It is customary with students to examine only stained specimen of sputum and usually only with the idea of finding tubercle bacilli. Hence these eggs would never be discovered. In doubtful cases of hemoptosis, therefore, examination of the sputum in the fresh stage should be made. (Lantern slides.)

CORRESPONDENCE.

LEGISLATION AGAINST TUBERCULOSIS.

TO THE EDITOR:—I wish to add a postscript to the statement in the "Report of Results of Nursing Dispensary Tubercular Patients" which appeared in the May BULLETIN, as to the failure of our health authorities to secure legislation to prevent the spread of tuberculosis. Since this Report was written, through the efforts of the Tuberculosis Commission of Maryland, the Legislature has passed an excellent law which has received the approval of the Governor. This provides for a compulsory notification of cases and deaths under penalty of a fine. Fumigation of an infected house, on the part of a landlord, before it can be let again, is also made compulsory under a fine of $25 if the law is not complied with. With this legislation Maryland can now be considered of the most advanced States in the crusade against tuberculosis.

REBA THÉLIN,
Visiting Nurse Johns Hopkins Hospital Tuberculosis Clinic.

NOTES ON NEW BOOKS.

Treatise on Diseases of the Skin. By HENRY W. STELWAGON, M. D., Ph. D., Clinical Professor of Dermatology, Jefferson Medical College and Woman's Medical College, Philadelphia. Third edition. With 220 illustrations in the text, 26 full-page lithograph and half-tone plates. (*New York, Philadelphia and London: W. B. Saunders & Co., 1904.*)

The necessity for a third edition of this work, within eighteen months, testifies to its excellence and to the need for a text-book on dermatology combining an abundance of good illustrations with a well written text.

While no material changes have been made in the new edition, the author has availed himself of the opportunity to revise and enlarge the methods of treating special diseases.

A short paragraph tells of the therapeutic value of both sun and electric light in psoriasis. Relapses, however, are quite frequent following the use of Roentgen rays.

The occasional brilliant results of the action of these rays on obstinate cases of acne vulgaris is noted and directions are given for their use. A measure of success has also attended the repeated application of high frequency currents in this disease.

The X-ray treatment of carcinoma cutis has been revised. The author advises its use until a "mild erythema or even decided dermatitis" is produced.

One sentence, however, is significant of the conservatism with which he regards the value of these rays. He says: "It is usually slow, and probably future observations will show that its special field of usefulness will be as an immediate supplementary measure to those already practiced and described above."

The reported favorable influence on cancerous growths following the application of radium is mentioned, but personal knowledge is wanting.

The treatment of lupus vulgaris and lupus erythematosus by the Finsen light, Roentgen rays and radium also shows the results of the author's efforts to bring the book abreast of the times.

Dr. Stelwagon is to be congratulated for the well merited success which the treatise has achieved.

A System of Physiologic Therapeutics. Edited by SOLOMON SOLIS COHEN, A. M., M. D. Vol. VII. Mechanotherapy and Physical Education. Part I. Massage and Exercise. By JOHN K. MITCHELL, M. D., Physician to the Philadelphia Orthopedic Hospital and Infirmary for Nervous Diseases. Part II. Physical Education by Muscular Exercise. By LUTHER HALSEY GULICK, M. D., Director of Physical Training in the Public Schools of Greater New York. (*Philadelphia: P. Blakiston's Son & Co., 1904.*)

This volume opens with "Massage and Exercise," by Dr. John K. Mitchell.

The use of physical methods, as a remedial measure, has in recent years grown extensively in importance, but authoritative

literature on the subject has been meagre. The appearance, therefore, of this treatise, coming from a physician whose name has long been connected with the subject, is an occurrence of special interest to the medical profession.

The book consists of two sections. The first of these treats of the "Principles, Methods and Therapeutics of Massage." A detailed and especially thorough consideration is given here to the diseases and conditions, both general and local, for which massage is deemed useful. Practical notes as to the methods to be followed and the selection of manipulations to be made are included in the description of each case.

Numerous details of practical interest, together with excellent descriptive illustrations, render the book useful to the masseur and student of massage, as well as of interest to the physician and surgeon.

One adverse criticism, however, must be made; namely, as to the definitions given of the fundamental manipulations of massage (pp. 22-23). These, it is believed, are intended by the author to be merely suggestive to the physician, rather than elaborated for the guidance of the masseur. Yet, because of the urgent demand for a wholly practical treatise upon massage, and because Dr. Mitchell's breadth of experience in this line of work will give to his book the weight of authority, it is to be regretted that these descriptions are not more complete, indeed, that they are lacking in essential points. For example, in the description of "circular friction," the fact which is indeed the basis of the whole movement, namely, that the fingers do not move over the skin, is omitted; in "pétrissage" (kneading), a manipulation in which this feature is also a distinctive part, the fact is named, but the reason given is a secondary one of dragging the hair upon the surface, and not the essential reason that if the hand moves over the skin its force is dissipated superficially and is not directed wholly to the underlying tissues.

Again, in the description of "effleurage" (stroking) only one form of the manipulation is named, and this is a somewhat elaborate stroke, which is indeed of special value upon normal surfaces, but which, it is usually conceded, is not otherwise as essential a manipulation as are simpler strokes that have not been described.

The second section, which is somewhat the larger part of the book, is entitled "Exercise as a Remedial Measure." This includes a description of helpful forms of exercise and of the various schools of physical culture, with explanations and comments. To these is added a discussion of the forms of exercise which have proved desirable as therapeutic agents in the treatment of special conditions, such as of obesity; gout; of spinal curvature and other deformities.

A chapter is devoted to exercise in the treatment of heart disease, outlining the Schott and Vertel systems. Numerous illustrations are included in this section also, and will be found useful aids in explaining the text in detail.

Special commendation should be given to the careful manner in which exercises are graded for convalescent patients.

The book is characterized by clearness of thought and moderation of statement, and as a whole is a valuable contribution to medical science.

American Edition of Nothnagel's Practice. Tuberculosis and Acute General Miliary Tuberculosis. By Dr. G. Cornet, of Berlin. Edited with additions by Walter B. James, M. D., Professor of the Practice of Medicine in the College of Physicians and Surgeons, Columbia University, New York. (*Philadelphia, New York and London: W. B. Saunders & Co., 1904.*)

There is probably no more difficult subject on which to write clearly than that of tuberculosis. The discussion of a disease with so many features about which there are so many debatable points can never be an easy matter. It seems to us that Professor Cornet has succeeded fully. The book as a whole is characterized by clearness, and the various points under discussion are dealt with in an able manner. The editor of this volume is Dr. Walter B. James, of New York, who has done his work extremely well. He notes in the preface that Dr. E. R. Baldwin has contributed a special chapter on the chemistry of the tubercle bacillus.

The volume opens with an excellent short historical review of tuberculosis. The morphology of the tubercle bacillus is then described and there is an admirable section on differentiation between the tubercle and the smegma bacillus. Th importance of distinguishing the tubercle from the pseudo-tubercle bacillus cannot be too strongly emphasized, especially in the diagnosis of renal and bladder conditions. Dr. Baldwin's chapter on the chemistry of the bacillus is complete and clear. There is an adequate description of the occurrence of the tubercle bacillus outside the body, and full reference is made to the work which has been done in regard to its occurrence in dust and in buildings. The section on the modes of invasion of the tubercle bacillus is exhaustive. The difficulties in demonstrating the source in many cases are pointed out, and the various possible portals of entry described. The importance of infection of the tonsils is especially dwelt on. The probability and frequency of infection of the intestinal tract is gone over at length; notwithstanding one cannot but wish that the author had either summed up the subject or given his own opinion more clearly than he has done. One is hardly able to obtain a definite opinion as to the author's position in regard to the question of intestinal infection. Naturally the subject of infection through the respiratory tract is discussed at length. The author points out in an interesting way the difficulties many of the older men had in accepting the view of direct infection of the lungs. The importance of Baumgarten's work in establishing the identity of tubercle and caseous pneumonia from a histological point of view is emphasized. In explanation of the fact that the upper air-passages are usually only secondarily diseased, though more often exposed to infection, the author points out that in the upper air-passages inhaled particles of dust, etc., are very readily swept up and gotten rid of, while in the deeper situations a great deal of the dust has to be carried by the lymph channels to the bronchial glands. He points out that, as regards the elimination of foreign material, the alveoli are in an unfortunate position, both as concerns dust and tubercle bacilli. Those which penetrate to the deeper parts tend to remain permanently. He considers that the tubercle bacilli behave in the same way as inactive particles of dust. One looks with interest for an explanation of the frequency of disease of the apices, but the author does not commit himself and gives no satisfactory explanation. Under the heading of infection of the pleura, the author considers that this is almost always secondary. We should like to modify his statement that "the demonstration of tubercle bacilli in the pleural exudate is *rarely possible*." This is very largely a matter of the way in which they are looked for and the care which is taken. With the precipitation and digestion of the clot of the pleural exudate the tubercle bacilli, with careful search, can be found in many of the cases. The editor notes this point, and we are able from experience to speak of its value. In the consideration of infection of the urogenital tract, the author lays a great deal of stress on the infections from without. Glandular infection is discussed at length. The next chapter is on the whole question of infection, which is discussed fully. It is comforting to find that the author considers the risk of infection from coughing to be very slight. Heredity and predisposition are next discussed, and the uselessness of drawing conclusions from small figures is strongly emphasized. "Statistics is the law of great figures."

The second part of the book is devoted to pulmonary tuberculosis. It is impossible to review this portion in any detail. The whole discussion will be found most satisfactory. The symptoms and diagnosis are fully taken up, together with the prophylaxis

and treatment. We would like to comment on the clear and definite way in which, throughout this entire section, special rules for treatment are laid down. This is a most important point. So many writers are content to merely give general directions, trusting to the intelligence of the readers to interpret them correctly.

The latter part of the book is taken up with a discussion of acute general miliary tuberculosis. In the opening section the author speaks of the difficulty of an explanation of the fact that general miliary infection does not occur in every case with a caseous focus. The importance of the relationship between tuberculosis of the blood-vessels and miliary tuberculosis is emphasized. The writer does not consider that there is any evidence suggesting that tubercle bacilli multiply in the blood. The differentiation of miliary tuberculosis from typhoid fever is discussed fully.

The volume contains a bibliography of nearly one hundred pages. As a whole the book is an exceedingly satisfactory one, and especially so in the clear, direct style in which the greater part of it is written. The additions of the editor are timely and have been put in with judgment.

American Edition of Nothnagel's Practice. Diseases of the Intestines and Peritoneum. By DR. HERMAN NOTHNAGEL, of Vienna. Edited with additions by DR. H. D. ROLLESTON, of London. (*Philadelphia, New York and London: W. B. Saunders & Co., 1904.*)

In reviewing the previous volumes of the American Edition of Nothnagel's Practice, we have had occasion to criticize the method in which the translation has been done. In this volume it is a pleasure to note that the translation has been very much better done and that the text throughout reads clearly. The credit for this, we rather suspect, is due to the editor, Dr. Rolleston. As is the case with many of these volumes, the present one is more suitable as a reference than as a text-book. The German authors, as a rule, run to diffuseness, and the obtaining of a clear, comprehensive view of any subject is apt to be more or less difficult from their works.

Throughout this volume there is considerable attention paid to the anatomy of the various conditions discussed, which we regard as a very valuable feature. The volume opens with a discussion of the chemical processes and the different bacteria of the intestine. Here, as elsewhere throughout the work, Dr. Rolleston has paid particular attention to the English and American literature, and it is interesting to observe what a considerable part it plays, particularly in the discussion of the bacteria of the intestine. Various conditions associated with mucus in the stools, fatty stools, etc., are discussed, and there is an interesting section on Intestinal Sand. Constipation is considered at some length. The discussion of the treatment is taken up under (1) dietetic; (2) physical; (3) medicinal. Under the second heading we are rather surprised to see that both walking and horseback riding are referred to as not having any special value in the author's experience.

The discussion of diarrhœa is interesting. The author describes a number of different types, which we should consider rather unnecessary, but the tendency towards elaborate classification and the multiplication of terms seems to be almost inherent in many of the writers on gastro-intestinal diseases.

Intestinal pain and intestinal hæmorrhage are discussed, and there is a considerable section devoted to catarrh of the intestine. One looks through this section with some interest to find out exactly what the author means by this term, but there does not appear to be any very satisfactory answer. A distinction is made between diarrhœa and catarrh; exactly what, it is hard to say. It is interesting to find the expression, "idiopathic rheumatic catarrh," used as a synonym for acute catarrh of the intestine. It is rather difficult to understand exactly the reason for this term.

The discussion of mucous colitis is very satisfactory. In the consideration of treatment, the author hardly seems to lay enough stress on the treatment of the patient's general condition, although he notes the necessity of this. The value of bowel irrigations is referred to. Ulceration of the intestine, as might be expected, is thoroughly discussed and many of the uncommon causes for it are noted.

The section on Stenosis and Occlusion of the Intestine is one of the most interesting parts of the book. This has been discussed at great length, and Dr. Rolleston mentions in the preface that he has had the aid of Mr. D'Arcy Power in the section on Intussusception. It is impossible to note all the features of this section, but some interesting points may be brought out. One is in regard to the use of the term "ileus." As is noted, there is no uniform definition of this term. The author defines "ileus" as the "symptom-complex produced when the passage of fecal matter through the bowel is completely interfered with." Many writers, however, use the term "ileus" only in cases of obstruction which are accompanied by fecal vomiting. As Professor Nothnagel remarks, there will be no harm done if the term "ileus" is eliminated from our nomenclature.

The section on the Diagnosis of Intestinal Obstruction is exceedingly good. One sees with pleasure that it is opened with the old rule that in every suspicious case there should be a careful examination of all the possible hernial rings and the rectum. It is not necessary to emphasize the unfortunate results that have followed from neglect of this rule. One of the chief problems discussed under diagnosis is as to whether the lesion is in the small or large intestine, and in association with this there are a number of very excellent plates exhibiting various patterns of abdominal conditions. Some of these are extremely good and they add greatly to the value of the work. An interesting point in the diagnosis of the seat of obstruction is the percussion note found in the upper lumbar region. The finding of a loud percussion note in this region the author regards as suggesting a stenosis of the large bowel. It would take too long to review at length the section on Diagnosis, but it can be recommended to all who are interested in the subject. In the section on Treatment, non-operative methods are discussed at some length, and the value of lavage of the stomach is highly recommended. The author points out that about one-third of all the cases of obstruction recover without operative interference. The indications for operation are well discussed. There is a section on Ascites and then follows a section on Peritonitis.

One turns with interest to the discussion of Appendicitis. The author seems to take a very sane, common-sense view of the question. Writing as a physician, he points out the difficulties in regard to treatment and the debatable points as to when cases should be operated upon. He lays emphasis on the fact that the indications for surgical treatment should be made more concise. Thus far, such a demand seems to be asking a little too much of the surgeons, for evidence of which witness the annual discussions in the Surgical Section of the American Medical Association. In the decision of the question of operation, cases are divided into groups. This is probably the most satisfactory way of dealing with the matter. As the author says, it is impossible to lay down general rules that will apply to particular cases. A discussion of the various forms of chronic peritonitis follows. In connection with tuberculous peritonitis, the author speaks very positively regarding the diagnosis, inasmuch as a case regarded as tuberculous peritonitis is rarely found to be anything else, although the disease is often found at post-mortem when it was not suspected during life. He notes the importance of recognizing the combination of a pleurisy or pericarditis with peritonitis. Operative treatment is not recommended strongly.

The book as a whole is a most satisfactory one. We must congratulate Dr. Rolleston on his work as editor. His additions are most valuable, and he has done what is most essential from our point of view in editing a foreign work, the giving of due credit to British and American investigation. It is a pleasure to see how carefully he has gone over the American literature.

A System of Physiologic Therapeutics. Edited by SOLOMON SOLIS COHEN, A. M., M. D. Vol. VIII. Rest, Mental Therapeutics, Suggestion. By FRANCIS X. DERCUM, M. D., Ph. D., Professor of Nervous and Mental Diseases in the Jefferson Medical College. (*Philadelphia: P. Blakiston's Son & Co., 1904.*)

In these days, when the profession talks very glibly of the "rest cure," sometimes, perhaps, not knowing exactly what is meant, a book such as this should be very valuable. As the title suggests, Dr. Dercum has divided the work into three parts, the first of which is devoted to the discussion of Rest. He describes first the various disturbances of function which occur, the chapter on which we think might perhaps have been elaborated to some advantage. He then proceeds to the discussion of what he calls "chronic fatigue" or "fatigue neurosis," both excellent terms, and lays special emphasis on the feeling of exhaustion.

Turning to the subject of Rest, he takes up first the partial rest methods, which seem very important. Many patients are quite unable to take an absolute rest cure, and must go on making the best of their surroundings. Dr. Dercum has laid out a very good régime for such patients. The radical treatment of neurasthenia is described at considerable length. We should recommend that this section be read by all those who are learning the handling of these patients. We are glad to see that the necessity of a proper mode of life after restoration to health is insisted upon. For the majority of these patients should be emphasized the fact that "work is the best guarantee of mental and physical health." This, of course, applies to many, but is not of invariable application. Some of our patients have "taken to work much as they would to dram drinking"—to quote the words of Huxley—and it is important to see that their labors are lessened. The treatment of conditions associated with neurasthenia is very well given, and the special modifications required in middle and advanced life are discussed. Under the heading of the Neurasthenoid States, Dr. Dercum emphasizes the importance of having a clear idea of what neurasthenia is. There are many conditions which do not really amount to the well-defined disease, but which are neurasthenoid states. As a necessary feature of neurasthenia he insists upon the presence of chronic fatigue.

Hysteria is then taken up and the essential features described. The necessity of a careful study of the patient is emphasized. The importance of the personal attitude of the physician is referred to, and the usual treatment is described. The next section is upon Hypochondria. To-day this condition receives very slight attention, and the probability is that, in comparison with neurasthenia and hysteria, it occurs very rarely. The positive diagnosis of hypochondria is not always an easy matter. The outlook in these cases, as Dr. Dercum notes, is often unfavorable. It seems to us that Dr. Dercum has included under this heading many cases which would more properly go under neurasthenia. The application of rest methods in various other neurological conditions, such as chorea, epilepsy, etc., is discussed.

The second part of the book is devoted to the Therapeutics of Mental Disease. The prophylactic measures are noted and the general principles are taken up. The merits of the rest treatment in the different forms of mental disease are discussed at some length. The indications for treatment and the methods are very clearly described. Under the heading of the treatment of the drug habits, rest is insisted upon in cases of chronic alcoholism, morphinism, etc. Naturally there remains a great deal to be added to the mere rest treatment. Under the head of cerebral symptoms from lead poisoning, the use of the iodids in ascending doses is advised. We do not think that such a statement should go by without qualification. In the more acute forms of poisoning, very much harm may be done and acute symptoms precipitated by the giving of large doses of potassium iodid. It is probably safer in many of the acute cases not to give iodid in any dose for a time.

The third section of the book deals with the use of Suggestion. The historical side is discussed in an interesting way and the various methods of hypnosis are described. The author does not speak especially enthusiastically regarding this method of treatment.

The style throughout is clear, the various therapeutic measures are well described, and the book can be recommended, especially to those who are beginning the handling of patients in whom rest is indicated.

A System of Practical Surgery. By PROF. E. VON BERGMANN, M. D., PROF. P. VON BRUNS, M. D., and PROF. J. VON MIKULICZ, M. D. Volume I. Surgery of the Head. Translated and edited by WILLIAM T. BULL, M. D., Columbia University, and WALTON MARTIN, M. D., Columbia University. (*New York and Philadelphia: Lea Brothers & Co., 1904.*)

An English edition of Bergmann, Bruns and Mikulicz's "Handbuch der praktischen Chirurgie" will be welcomed by those who have not had access to the original work, as well as by those who are deficient in foreign languages. The present volume, dealing with the head, is the first of four large books which after the fashion of "systems" that have already appeared in English by English and American authors will endeavor to cover the entire field of surgery.

The names of Bergmann, Krause, Krönlein, Kümmel, Kütterer, Lexer, Schlatter and Wiesmann that make up the list of contributors to this volume are a sufficient guarantee of the excellence of the material comprising the several chapters. The particular subjects with which their names are already familiarly associated have been extensively reveiwed by one or another of these well-known writers.

The editor of the present edition expresses his conviction that the volumes "will be found of inestimable value to the student and the scientific surgeon" and there can be no doubt of the truth of this statement. From the student's standpoint, however, the ideal text-book is yet to appear, and valuable as are these volumes they will unfortunately be over the heads and beyond the means of the average undergraduate. The "scientific surgeon" will seriously miss two features which he might have expected to appear in this American translation. One is the introduction into the context of the more recent American contributions on the various subjects dealt with. If this has been done at all, the additions have been so fused with the original articles as to render them indistinguishable. Still more to be regretted is the omission of the important bibliographical references which accompanied the chapters of the German edition, one of its most valuable features. It is greatly to be hoped that this loss will not characterize the ensuing volume.

The German method of italicizing important words, sentences or passages which enable the reader to quickly gather the main facts presented, and also of printing the paragraphs of minor importance in smaller text than the main subject-matter when the context is to be more studiously gone over, are features which could well be imitated by American publishers of scientific works.

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even receded; often there has appeared some invention or discovery for which the time was not ripe and which had to await for its fruitful application or perhaps its rediscovery a more favorable period, it might be centuries later.

There is a most intimate interdependence of physiology, pathology and surgery. Without progress in physiology and pathology, surgery could advance but little, and surgery has paid this debt by contributing much to the knowledge of the pathologist and physiologist, never more than at the present time. Harvey's immortal discovery marks an epoch for surgery, as it does for all medicine, for without knowledge of the circulation of the blood only the most primitive kind of surgery is thinkable. And yet there is abundant proof that the ligation of vessels, with the introduction of which Ambrose Paré (1517-90) has until recently been accredited, was known to the school of Alexandria; carried, it is said, to Rome by Euelpistus, it is mentioned by nearly all surgical writers of importance from Celsus to the Renaissance. The brilliant Fallopius (1523-62), Paré's contemporary, alas a very short-lived one, wrote much about the use of the ligature for the arrest of hemorrhage. Nevertheless, until Harvey demonstrated (1628) the true course of the blood, the principles underlying the control of bleeding by the ligature could not be understood, and surgeons studiously avoided operations which entailed hemorrhage and necessitated its control.

We can hardly understand in these days that surgeons who were at the same time anatomists and physiologists could have accepted for so many centuries, almost without remonstrance, Galen's views. Our inability to comprehend their state of mind with reference to this problem illustrates particularly well the difficulty experienced when we attempt to transport ourselves to other times, to obtain the point of view which subjugated our forefathers of centuries ago. It is now, as it was then and as it may ever be; conceptions from the past blind us to facts which almost slap us in the face. The blood which spurted from the divided artery was believed to come not from the left heart, but in some mysterious and indirect way from the veins, in which it was supposed to flow and ebb to and from the right heart. Harvey knew nothing of the paths by which the arterial and venous systems communicate, and his discovery was not made complete until Malpighi in 1661 demonstrated by the microscope the capillaries.

How bewildering hemorrhage must have been when a wound suddenly filled with blood from a source unknown, and when sometimes, with little bleeding, a patient suddenly died from aspiration of air into the veins! What more natural than to pack quickly the wound, as Heliodorus and others were wont to do, with compresses of lint or sponge, to ligate large masses of tissue by circumvection, to draw the bleeding edges of a wound tightly together by stitches, as is still sometimes done, or to sear the bleeding surfaces with the cautery or with boiling oil! Imagine the terror and suffering of the patient, the desperation and haste of the surgeon, conditions not suited to the tranquil pursuit of physiological knowledge.

In all times, even to the present day, the surgeon's chief concern during an operation has been the management of the blood vessels. The fear of death on the table from hemorrhage has deterred many a charlatan and incompetent surgeon from performing otherwise perilous operations. The care exercised in the control of hemorrhage may constitute the chief difference between a rapid and a slow operator. This was eminently the case in the days within my experience when two or three artery clamps were considered abundant for operations which now require one or even two hundred.

The five things declared by Paré, usually designated as the father of French surgery, as proper to the duty of a surgeon may serve to indicate how restricted was the field of surgery before the course travelled by the blood was determined:

1. To take away that which is superfluous, as in amputations.

2. To restore to their places such things as are displaced, as in hernias.

3. To separate those things which are joined together, as in parts rendered adherent by burns.

4. To join parts which are separated, as in stitching up a wound.

5. To supply the defects of nature, as in setting an eye, an ear, a nose, or one or more teeth; filling up the hollowness of a defective palate with a gold or silver plate.

The studies of Hunter, born just one hundred years after Harvey published (1628) his demonstration of the circulation of the blood, and about seventy years after Malpighi discovered the capillaries, on the healing of wounds, on inflammation, on the ligation of arteries, were made possible by the discoveries of these great investigators. John Hunter's (1728-1793) name is eclipsed by that of no other surgeon, and for the fame of his contributions, particularly to biology and physiology, an inextinguishable lamp will forever burn. Let us remain with him, if only for a moment, for he is an inspiration and a teacher for us all, as great perhaps for his time as the world has seen or will ever see again.

How fascinating to follow the groping in the dark and the searching for the light of a great mind! How refreshing and what a lesson is his honest doubt! "I am not able under such circumstances," he writes,[5] decidedly to say which is the best practice, whether to leave the slough to separate, or to make a small opening and allow the blood to escape slowly from the cavity." And again, speaking of that common class of injuries in which the wound communicates externally and the blood has formed a scab over the breach, he says:[6] "But this operation of nature reduces the injury to the state of a mere superficial wound, and the blood which is continued from the scab to the more deeply seated parts, *retaining its living principle* [italics mine], just as the nat-

[5] Hunter, Palmer's ed., Vol. III, p. 247.
[6] Op. cit., p. 252.

ural parts do at the bottom of a superficial wound, the skin is formed under the scab in the one case as in the other; yet if the scab should either irritate or a part underneath lose its uniting powers, then inflammation and even sometimes suppuration may be produced." Here Hunter recognizes facts which have been fully appreciated only in recent years, that there is a power for good in the blood, that the blood clot has a value and should be undisturbed, and that the dry scab usually desirable is sometimes harmful.

Under the conditions existing until the time of Hunter near the end of the eighteenth century, it was doubtless right that the practising surgeon should have been sharply differentiated in social position and professional standing from the physician proper, the latter being equipped with all the academic knowledge of the time, the former an apprentice of the barber shops. "The reasoning of the army surgeons endured as butter in the sun," wrote Abraham a Gehema in 1690, and the army commanded the services of the best surgeons. Nevertheless, it is often refreshing to find records of sound personal observations in the writings of the old surgeons, who, rude and unlettered though they might be, were dealing with realities at a time when the minds of physicians were buried in scholastic subtleties and fruitless speculations. In the German universities, when chairs of surgery were first created, it was considered beneath the dignity of the physician who taught the doctrines of this art actually to practise it. Thus Haller (1708-77) about the middle of the eighteenth century taught, among other things, surgery both in Goettingen and Berne, but never demeaned himself to perform an operation. Billroth,[7] commenting on this arrangement, says: "That Albrecht von Haller in Berne should for many years have lectured on surgery without ever having touched a single human creature with the knife is for us, in these days, hard to comprehend." How different apparently from Haller's was the attitude of mind at that time of John Hunter (1728-93) in England, whose practice yielded a yearly income of six thousand guineas; and yet in spirit perhaps not so different after all, as exemplified by the remark to an assistant, "Well, Lynn, I must go and earn this damn guinea, or I shall be sure to want it to-morrow."

Even in America a little more than a hundred years ago a definite stigma still adhered to the exercise of the surgeon's art. Thus writes the eminent Dr. John Morgan, founder of the Medical Department of the College of Philadelphia, later the University of Pennsylvania, in a letter from London, November 10, 1764, to Dr. Cullen, after a long period of study abroad: "I am now preparing for America to see whether, after fourteen years of devotion to medicine, I can get my living without turning apothecary or practitioner of surgery."[8]

It was not until the year 1800 that the Royal College of Surgeons received its charter, and then only with great difficulty. Parliament had again and again refused to grant a new charter to the disbanded "Company of Surgeons." Lord Thurlow is reported to have said in the House of Lords when the bill had passed the Commons: "There is no more science in surgery than in butchering," and it was only when the Court of Examiners, a body still in existence, decided to appeal to the Crown, to King George III, that the charter was ultimately obtained. From the days of the great Hohenstaufen, Frederick II, who in 1231 commanded the teachers at Salernum diligently to cultivate the art of dissection, up to the present time medicine has repeatedly been aided and advanced by the enlightened intervention of kings and rulers. When Maria Theresa brought Gerhard van Swieten from Leyden to Vienna in the face of great opposition from the profession, she laid the foundations of the fame of the medical school of Vienna and she placed to her credit an achievement from which Austria and Germany still profit. In Prussia medicine has enjoyed the support of the Crown without interruption from the time of Frederick I to the present day. The splendid new equipment of the surgical department of the University of Berlin is largely the result of Emperor William II's wisdom and liberality. "A king or a privileged class," writes President Hadley,[9] "ruling in accordance with traditions and trying to act for the interests of the people, will give a much larger measure of real freedom than is possible under a democracy whose members have no respect for the past and no higher aim than their own selfish advancement."

The founding of the Academy of Surgery in Paris, in 1731, has been referred to as the turning stake in the history of surgery, as the starting line of its scientific labors and of its true career, and the French regard the five anatomical demonstrations made a few years before by the surgeon La Peyronie in the College of St. Côme as the inauguration of the new epoch. Von Bergmann reminds us that a Theatrum Anatomicum for students of surgery was erected in Berlin in 1713, but this exerted no such wide influence as the Paris Academy. The development of clinical teaching can be traced by unbroken tradition directly to Boerhaave, professor at the University of Leyden in the early part of the eighteenth century, and a teacher of unsurpassed influence and renown. His pupils carried the new methods to Austria, to Germany, to Edinburgh, and their descendants in the faith were the founders of the early medical schools in this country. In its influence upon the development of medical teaching the University of Leyden occupies historically the first position.

The relation of surgery to general medicine at the end of the eighteenth century was in Germany much less satisfactory than in Great Britain and in France. Under the teacher of clinical medicine was a surgeon who demonstrated the surgical cases. When Reil was called from Halle to Berlin in 1810 as professor of medicine, he naturally expected that the customary relations would be preserved and that Carl Ferdinand Graefe, a young protégé of Wilhelm v. Humboldt,

[7] Lehren u. Lernen, p. 45. Wien, 1876.
[8] Packard, The History of Medicine in the United States, p. 191.

[9] Arthur T. Hadley, The Relations between Freedom and Responsibility in the Evolution of Democratic Government. Chas. Scribner's Sons, 1903.

would operate under his direction. But by a mandate from the throne the independence of Graefe and of surgery was established. Graefe was given a responsible post as army surgeon, and his services in war were of such a high order and so greatly esteemed by the King that an independent surgical clinic was soon established and entrusted to him. The first equipment of this clinic was a very modest one, conforming to the straightened condition of the state's exchequer. Five times in the first nine years of its existence his hospital of ten beds was obliged to seek new quarters, but in 1818 it was located at the site of the present surgical clinic of the University of Berlin. Philipp v. Walther, his illustrious contemporary, gives his impressions of Graefe's clinic, which he visited in 1834: "A remarkable, splendid spectacle, conducted in a dauntless and highly gifted manner is Graefe's clinic in Berlin; we have no prototype of it either in France, England, North Italy or Holland. Its disposition is entirely national, purely German." "What changes have taken place in a single generation," writes von Bergmann,[10] "changes brought about by the same indefatigable activity of the German clinical teachers and by their absolute devotion to their work, the devotion springing from innermost convictions which made it possible for Graefe after fifteen years of clinical toil to win such testimonials from his fellows."

In the year 1876, the year when I first walked the wards of Bellevue Hospital, New York, the dawn of modern surgery in America had hardly begun, and it may be of interest to note some of its characteristics at that time. The discovery of ether was not so old as to have obliterated all traces of the old surgical rule, "Cito, tuto, jucunde," but the rapid method of operating was gradually giving place to the safer one. Conservative surgery was made possible by general anæsthesia, as was illustrated particularly well in the exsection of joints and the subperiosteal resection of bone. The discovery of the ophthalmoscope, an invention of incalculable importance, had led to the establishment of the specialized eye surgeon, and it soon proved a great boon to general surgery, leading as it did to the adoption of innumerable specula and mirrors for the examination of hitherto unexplored regions. As a result of a reaction against bleeding and against the reckless waste of blood at operations, there developed a fondness, almost a mania, for bloodless operations, for styptics and the actual cautery, for écrasement linéaire (Chassaignac), for galvano-puncture and electrolysis. To the employment of galvano-puncture in the treatment of arterial angiomata is due the introduction by Pravaz of the hypodermic syringe, which it is interesting to note was originally designed solely for the purpose of conveying to these growths a substance (solution of chloride of iron) capable of producing coagulation. This little instrument, destined soon to play a part so useful, so indispensable, entitles its inventor to the lasting gratitude of mankind.

None of these methods for the bloodless division of tissues was destined to supplant the knife, so that surgeons became interested in devising better means for the prevention of loss of blood. In 1873, at the German Congress of Surgeons, in Berlin, von Esmarch gave to the world his method of producing artificial bloodlessness ("die künstliche Blutlehre").[11]

But no truly great and essential progress in fundamental surgical principles had been made since Hunter's time, until the monumental labors of Pasteur opened the vista through which for a time only the eyes of Lister could peer. It is hard to realize that forty years have passed since Lister and Pasteur made to surgery a contribution rivalled only by Harvey's in importance. It was in 1867 that Lister first made known the almost incredible results of his experiments with carbolic acid in the treatment of wounds. The great merit of Lister lies in his clear recognition of the significance of Pasteur's discoveries in revealing the underlying causes of the infection of wounds and in the adoption of measures fitted to prevent and combat such infection. This merit will remain whatever changes may be made in the details of antiseptic and aseptic surgical procedures.

It was not, however, until 1875 that even in Germany Listerism obtained a substantial foothold. How I should like to tell the true story of this period in this country and abroad, to do full justice to Lister and his few faithful disciples in the United States and Great Britain, who for nearly twenty years contended with prejudice and parried the almost venomous thrusts of the skeptical and the envious.

[10] Die Entwickelung des chirurgischen Unterrichts in Preussen. Berlin, 1893.

[11] Verhandlungen der deutschen Ges. f. Chirurgie, 1896. (The Jubilee Congress.)

Von Esmarch is one of the very few surgeons living who, even as a student, can recall the days before anæsthesia. He maintains that he who was not a participant of those times cannot picture to himself the enthusiasm which took possession of every physician, and particularly of the students in the surgical clinic. Whereas before the introduction of ether, the operating rooms were filled with the groans and shrieks of the unfortunate victims, the appalling spectacle causing many students to faint, now, of a sudden, absolute quiet reigns, a stillness almost supernatural, broken occasionally by the senseless chattering or joyous singing of the patient.

Familiarity with the use of cocaine in surgery has robbed somewhat the pre-anæsthesia days of their interest to the surgeon. We used to admire and wonder at the courage of the old-day surgeons who could inflict such torture for such small rewards, but we know now that certain operations can be performed with very little pain even without the employment of a local anæsthetic. It is often unnecessary to do more than anæsthetize the skin to perform a very considerable operation, in the neck for example. From cocaine we learned in one year (1885) more about the relative sensitiveness of the various tissues and organs than from all the literature of our forefathers. The skin being anæsthetized and incised, we were surprised to find that the underlying parts were comparatively insensitive to handling and, for the most part, even to cutting. The accidental cutting or crushing of nerves caused the most exquisite pain, and we noticed that the nerve supply of the blood vessels[12] is so abundant that the severing or clasping of even very small bleeding points usually startled a cry of some sort of remonstrance from the patient; and now after many years of experience with cocaine we interpret an unexpected moan as signifying an insult to some small unseen blood vessel or nerve. These facts learned, I say, in one year, perhaps in six months of experimentation with cocaine, were not clearly revealed by all the previous ages of surgery. The explanation undoubtedly lies in the facts that in olden times the first cut through the skin so unnerved the patient and perhaps the surgeon that differentiation was impossible, and that the operation was performed in such haste as to preclude careful observation. I fear that so much practice with cocaine as an anæsthetic has obtunded to some extent our sensitiveness to pain in others. Formerly it taxed one severely to employ cocaine in certain operations which we now perform with equanimity; we are in danger perhaps of acquiring the kind of immunity (it is not indifference) which it seems to me dentists possess or have cultivated to such a high degree. Briefly, then, the story of the surgery of pre-anæsthesia-days has become less interesting because it has been robbed of its terrors by the lessons which cocaine has taught us. If the surgeon of the past could only have known what it seems to the modern surgeon he should have known better than all else, namely, the relative sensitiveness of the various tissues, he could hardly have failed to discover methods of producing anæsthesia of the skin. That one could deliberately divide a nerve of the size of the sciatic or ulnar or even the minutest filaments visible without exhausting his ingenuity to find something to deaden the exquisite or agonizing pain seems inconceivable. How blind we are and how blind we ever shall be.

[12] John Hunter recognized the fact that parts richly supplied with blood were much more sensitive than the comparatively bloodless parts.

Why was Germany the country first to adopt antiseptic surgery? Why did almost every surgeon in every German university eagerly embrace Lister's system almost at the same moment and as soon as it was clearly presented? The answers to these questions are, I believe, to be sought mainly in the character of the scientific and practical training of surgeons in Germany, and it is especially upon the question of the training of surgeons that I wish to dwell in the remainder of this address. What I shall have to say relates not so much to the mere teaching of surgery in the undergraduate curriculum, as to the requirements for the training of those who desire to fit themselves for a career in surgery.

Thirty years ago as I sat upon the benches, often seven hours a day, listening to medical lectures, I was so impressed with the characters and lives of some of my teachers that I believed they represented all that was most advanced in medicine. But a day in Halle, at the clinic of Volkmann, was a revelation to me. There I heard by one of the young assistants at the early morning clinic an impromptu discourse on epithelioma at which I marvelled. At home the whole subject of tumors had been treated of in one lecture, in one hour, in the "tumor lecture." Attending the Congress of German Surgeons, which each year takes place at Eastertide in Berlin, I heard the subject of hip joint tuberculosis discussed. One surgeon alone reported on six hundred cases, more or less, some of which he had observed twenty years or longer and most of which he had been able to follow. His methods of observation were new to me; his knowledge was inspiring; I was thrilled by his masterful exposition. Within two weeks, by a strange coincidence, I found myself attending in America a meeting of a very superior "surgical society" in one of our large cities, at which the same subject, "morbus coxarius," was under consideration. Only one of the surgeons had had an experience of as many as twenty-eight cases, and of the subsequent history of most of these he knew very little. The contrast was not only in the knowledge and presentation of and interest in the subject, but in the audience. The Deutsche Gesellschaft für Chirurgie admits to its fellowship any reputable surgeon of any country of the world, and its halls at each Congress are filled and overflowing. The membership of the select "surgical society" was limited to twenty and the average attendance was less than this number.

It may be that the rise and multiplication of proprietary schools of medicine without organic connection with a university was a necessary incident in the rapid growth of a new country, but it is absurd to expect them to yield results in the education of physicians and in the advancement of knowledge comparable with those of the well-supported medical departments of European universities. It is difficult to free either the educated public or our universities from the reproach that they remained so long indifferent to the needs of higher medical education. The times are changing and we have learned in our own time, indeed within a decade, how superior in all respects is the endowed university medical school to the old-time proprietary school. Who would have believed that one or two well-utilized endowments could have achieved in so short a time so much? It was not only because some of the best men in this country were attracted to the university medical schools, fortunate enough to be so endowed, that the great progress was made; it was also because the further development of these men was made possible by the opportunities which they proffered and the atmosphere which they developed. The influence of these men, comparatively little before, almost at once, under the new auspices, was felt, not only in this country, but abroad. The growth of these men and of these schools has been so great that they are already well known and honored in all civilized countries. Much of what Welch foretold here in 1888 and in Cleveland in 1894 [13] has already come to pass.

Although we now have in the United States several (five or six) moderately well-endowed medical schools with a university connection, the problem of the education of our surgeons is still unsolved. Our present methods do not by any means suffice for their training. Do we require stronger proof of the inadequacy of these methods in producing young surgeons than is presented by the so-called sacrifices which our young men to-day are willing, nay, most eager, to make in order to obtain a training which seems even to them not only desirable but absolutely essential for success of a high order? Here I may be permitted to instance conditions which have evolved in a natural way at the Johns Hopkins Hospital, where the plan of organization of the staff differs from that which obtains elsewhere in this country.[14] The average term of service for the interne on the surgical side who succeeds to the house surgeonship in this hospital is at present eight years—six years as assistant, in preparation for the position, and two years of service as actual house surgeon. Adding to these the four years in the medical school and the junior and senior years in college, which in some colleges may well in considerable part be devoted to branches introductory to the study of medicine, the prospective house surgeon has to contemplate twelve or fourteen years of hard work, very hard

[13] W. H. Welch, Some of the Advantages of the Union of Medical School and University. New Englander and Yale Review, Sept., 1888.
Higher Medical Education and the Need of its Endowment. Medical News, July 21, 1894.

[14] The surgical staff consists of nine men, eight internes and one externe. The externe is an assistant in surgical pathology, he attends operations whenever it seems desirable in order to do with a clearer understanding the pathological work, to take charge of and describe[15] the pathological material obtained at operations and to keep in touch, for his own benefit, as well as for the sake of the surgical department, with the clinical work. Four of the internes serve for one year, only the honor men of each class at graduation being entitled to these positions; but the *permanent staff*, so-called, consists of four men, the house surgeon and three in line of preferment. Men from any part of the country, if they have had the proper training, are eligible for the permanent positions. Great care is exercised in the filling of the vacancy on the permanent staff, which occurs once in two or three years, and advancement is not guaranteed to the appointee. The House Surgeon's term of service is still optional. He receives a salary; the other assistants are not paid. The assistants are expected in addition to their ward and operating room duties, to prosecute original investigations and to keep in close touch with the work in surgical pathology, bacteriology and, so far as possible, physiology.

[15] I am sure that much of the material for surgical pathology can be correctly described only when it is perfectly fresh. It cannot be painted because in less than a minute, in a few seconds often, the appearance of a freshly cut surface is greatly changed. Only those who are well trained as macroscopic pathologists, who have naturally a discriminating eye for color, a good sense for form and some talent for expression can properly describe the fresh material. Many, if not most, of the descriptions are worthless or at best serve only as reminders to those who can distinctly recall the case. The descriptions, by two trained men, of ordinary fresh material may differ so greatly that one could not believe they pertained to the same specimen. Color photography might be employed, it seems to me, with great benefit, for recording the appearance of fresh specimens.

work, in order to secure this prize to which in this country of necessity only a very few at present attain. Thus far the success of the three or four men who have received, approximately, this training is so convincing that the very best graduates of our own and other schools are eager for the opportunity to be tested as to their fitness to rise to the position; and I know from applications which have been made to me this year that men of the desired quality would gladly serve ten years on the surgical staff in order to obtain the experience which the house surgeonship and the training leading to it affords. The number of years which an interne who has become house surgeon is expected to serve with us is not and never has been prescribed.

It will be objected that this is too long an apprenticeship, that the young surgeon will be stale, his enthusiasm gone before he has completed his arduous term of service. These positions are not for those who so soon weary of the study of their profession, and it is a fact that the zeal and industry of these young assistants seem to increase as they advance in years and as their knowledge and responsibilities become greater. Nowhere certainly can a surgeon in a given period acquire so much, mature so rapidly, as in a hospital with an active and properly-conducted service. The time devoted to the training in surgery of those who hope to be teachers should not be curtailed, but young men contemplating the study of surgery should as early in life as possible seek to acquire knowledge of the subjects fundamental to the study of their profession.

It was our intention originally to adopt as closely as feasible the German plan, which, in the main, is the same for all the principal clinics of the German universities. The house surgeon, or first assistant, as he is called in Germany, is selected, after several years of service, from a number of well-tried assistants. There is no regular advancement from the bottom to the top of the staff of resident assistants. Only a small proportion of these venture to entertain the hope of becoming first assistant. Occasionally an assistant from another clinic may immediately, or almost at once after transfer, succeed to this position over the heads of those who have served many years. This admirable system, which undoubtedly has its disadvantages, is possible only in a country where like conditions prevail and a close affiliation exists between the universities or where some great inducement exists for the making of assistants of the highest possible order. The professor of surgery, or the surgical chief, desires to secure as his first assistant or chief of staff a man of great promise, not only because of the obvious immediate advantage to the clinic, but because such an assistant is likely to have tendered him, ultimately, the chair of surgery in some smaller university. It is a matter of great satisfaction and pride to a professor of surgery to have supplied from his staff one or more university chairs. So, too, it is a great disappointment and sometimes a keen sorrow to the professor of surgery when his scholarly, highly-trained and devoted first assistant after a service with him of eight or nine years is compelled to resign himself to an instructorship, to content himself with the title "Privat-Docent." This occurs often, in fact is usually the case, because there are so many more retiring first assistants than there are vacant chairs of surgery in the twenty German universities. Whenever, consequently, there occurs by the death or voluntary retirement of a professor of surgery, a vacancy in a university, there are possibly twenty first assistants and perhaps as many Privat-Docents hoping for promotion, not necessarily to this particular university, for the vacancy, unless it is in one of the smallest universities, is usually filled by the professor in a still smaller one.

What are the inducements which make it worth while for the young men in Germany to devote so many years to preparation for the practice of surgery, what the careers to which they aspire, and what manner of men are they who furnish by their example and by their achievements the great stimulus?

Not only the first assistants but all the members of the surgical staff of one of the great university clinics in Germany enjoy almost ideal facilities for learning surgery and for prosecuting researches. The amount of clinical material is great. The operative work begins early in the morning and often does not cease till late in the afternoon. The outpatient department is controlled by the chief surgeon and is conducted by his assistants; a patient when discharged is consequently not referred to some dispensary or other and lost sight of. The pathological material obtained at operation is carefully worked up in the special laboratories for surgery and, if need be, is preserved in the museum, which should always be an important feature of the surgical department of a university. Every facility and the greatest encouragement is given each member of the staff to do work of research.

Although during the eight to twelve years of hospital service as assistant in some large university clinic he has laid the foundation of his reputation, the real life work of a German surgeon begins when he is invited to fill a professorial chair. He now longs to prove himself worthy of the new position, he has the incentive to inspire others to achieve, he measures himself by a new standard, and there is born in him the desire to rise higher, to sow the seed which will produce a bloom worthy of the greatest universities, possibly even of Berlin. In European countries no effort, no amount of time, few sacrifices would be considered too great if thereby the chair of surgery in a university might be secured. In Germany the prestige of the position is something that we in the United States who have not lived abroad cannot truly comprehend. In each university the chair has its imperishable traditions, its long line of famous surgeons, whose names are cherished and revered for their services to science, to their universities, to their country and to their fellows. In the nineteenth century, to mention only some of those who have passed to the majority, in the University of Berlin, were v. Graefe, Dieffenbach, v. Langenbeck; in Vienna, Vincenz v. Kern, Billroth, Albert; in Heidelberg, v. Chelius, Carl

Otto Weber,[16] Gustav Simon; in my student days there were in Leipzig, Thiersch; in Halle, v. Volkmann; in Bonn, Busch; in Tübingen, Victor v. Bruns; in Munich, v. Nussbaum; in Strassburg, Lücke; men of great renown, every one. To enroll one's name with such as these, to inherit something of their skill, their knowledge, their zeal, their honor, their sense of duty, is not this worth while? The professor of surgery in Germany is usually a man of great influence and power. His affiliations, his responsibilities, his knowledge of surgery and the allied sciences, and often of art, of music, of literature and of the world's affairs, produce a type of man which his country may well contemplate with pride.

America, too, in spite of discouraging circumstances, has produced great surgeons, but it is to be deplored that here conditions prevail which hitherto have not encouraged, if they have not actually prohibited, such special development as I have outlined. I have known professorial chairs in one of the principal medical schools of this country to go actually a-begging—a-begging, of course, only of men who would adorn the position. Recently I asked a prominent surgeon, to whom a chair in one of our chief universities had been offered, why he had not accepted it. He replied that his practice was a large and lucrative one and that he had neither the time nor the inclination to prepare and deliver one hundred lectures, more or less, a year. Young men are naturally only too glad and eager to secure a professorship which would insure a good living and a certain distinction, but older men who are already well known and with an assured income have no inclination to undertake teaching of a prescribed kind for which they are not trained and for which the rewards are not in their opinion proportionate to the labor. Even to those who have held the chairs of surgery for years the work sometimes becomes so irksome that they seek to abandon it as soon as directly or indirectly it ceases to yield a sufficient return.

The faults of our system of educating surgeons begin almost at the bottom and continue to the very top. I am considering only the training of the best men, those who aspire to the higher career in surgery. On graduation they become hospital internes, but their term in the hospital is only one and a half, occasionally two years, only a little longer than the term of hospital service required in Germany of every applicant for the medical degree and not so long, on the average, as that required of each medical graduate of the University of Tokio. The interne suffers not only from inexperience, but also from over-experience. He has in his short term of service responsibilities which are too great for him; he becomes accustomed to act without preparation, and he acquires a confidence in himself and a self-complacency which may be useful in time of emergency, but which tend to blind him to his inadequacy and to warp his career. A surgeon should find his greatest stimulus and support in his assistants with whom he spends or should spend many hours a day; but this is only possible when they have had opportunities for sufficient development.

Think of the labor of breaking in two new house surgeons each year and of the incompleteness of their work. "I thought I had instructed you to examine the vocal chords after every goitre operation," complains the attending surgeon; "No, it must have been my predecessor or some other house surgeon whom you so enjoined," replies the interne. It is a grave mistake, it is a shame to check suddenly the advance of these superior young men who are tense with enthusiasm, who rejoice in the work to which they hope to be able to dedicate their lives. It is from these men, we must not forget, that our teachers of surgery are made.

But much as the interne suffers from the brevity of his hospital experience, the hospital suffers more and the surgeon most. Every important hospital should have on its resident staff of surgeons at least one who is well able to deal not only with any emergency that may arise and to perform any operation known to surgery, but also to recognize the gross appearances of all the ordinary pathological tissues and lesions.[17] But the interne leaves the hospital unequipped; eventually, it may be, he secures the position of attending surgeon to some hospital and then he is expected to teach others to perform operations which he himself has not learned to do, and to pronounce at the operating table upon conditions with which he is not familiar and which possibly he has never seen nor heard of.

We need a system, and we shall surely have it, which will produce not only surgeons but surgeons of the highest type, men who will stimulate the first youths of our country to study surgery and to devote their energies and their lives to raising the standard of surgical science. Reforms, the need of which must be apparent to every teacher of surgery in this country, must come on the side both of the hospital and of the university, and it is natural to look to our newer institutions, unhampered by traditions and provided with adequate endowment, for the inception of such reforms. It is eminently desirable, if not absolutely essential, that the medical school should control a hospital of its own. There should be

[16] Weber. It is interesting to note that Weber, professor of pathological anatomy at Bonn, at the instigation of Helmholtz, was called (1865) after long deliberation to succeed Joseph von Chelius in Heidelberg. Much astonishment was naturally expressed that a pathologist should be invited to take a surgical chair, but the choice proved a most happy one, and although Weber lived to teach surgery only five semesters, he left in Heidelberg ineffaceable impressions of his great activity and learning.

In the days when operations the world over were few and far between, and when little was known of surgical pathology, it was natural and reasonable that particular stress should be laid upon a careful training in anatomy in preparation for the practice of surgery; but now when time is so short and the art of surgery so long and the operative material so abundant, the prospective surgeon's work in anatomy should be very much curtailed to give time for a very thorough training in pathology and also in physiology. The more definite the knowledge of a subject becomes, the more easily it is acquired. The surgeon should quickly master the anatomy which he requires, and gross pathology will soon be for him an easily explored field; he already looks to physiology for his particular field of research. The value to the surgeon of patient dissection of many injected and hardened cadavers is very much overestimated. The general topography of a part can be quickly and sufficiently recalled by reference to an illustration; it is a knowledge of the fasciæ that the surgeon who wishes to perform an operation deftly and neatly requires, and this can be acquired only by rapid dissection of perfectly fresh material, or better still, of course, by frequent repetition of the particular operation. A hundred dissections of the embalmed neck would not shed much light upon the operations for the removal of goitre nor even of the ganglia of the sympathetic. I am speaking from the standpoint not of the student, but of him who wishes to operate artistically.

[17] The internes should be encouraged and afforded every facility for the prosecution of work in research.

such an organization of the hospital staff as I have indicated, providing the requisite opportunities for the prolonged and thorough training of those preparing for the higher careers in medicine and surgery, and permitting the establishment of close and mutually stimulating relations between chief and assistants.

The professors of medicine and surgery occupy a peculiar position. They are teachers in the universities and at the same time teachers in the technical schools, the hospitals, which in this country are in only one or two instances, unfortunately, under the control of the university. As university instructors it is still a question just how much of the technical they shall teach, and as workers in the technical school, the hospital and in private practice, how much time they shall devote to laboratory investigation. It is doubtful if an ideal adjustment, if there were such a thing, could always be preserved, because in one individual there reigns a passion for laboratory pursuits, in another the love of the practical and the rewards which practice may bring. Barker has recently, in his memorable address,[18] mooted this subject. Emphasizing the evils of the proprietary school and the inadequateness of what he designates as the "pseudo-university school," he proposes the name "semi-university school" for the "six or eight best medical schools in the United States," for the reason that only the subjects of the first two years are taught by men (university professors) "who do not engage in the private practice of medicine" and "who give their whole time and energies to the teaching and investigation of the sciences which they represent." It is to be noted that the true "university medical school," in the sense in which this designation is used by Barker, exists nowhere and probably never has existed.

The professors who teach in the departments of the last two years "are either not paid at all or are paid small sums, almost always less than the remuneration which pertains to a university chair, and almost always too little to provide the professor with a living income." "It is obvious," Barker continues, "that if those who teach the clinical subjects have to make their living from private practice, they will be compelled to direct their activities so as not to interfere with that practice." And further, he says, "I should like to see what the result would be if men with these capacities were bred to university careers, were placed in charge of hospitals especially constructed and endowed for university purposes and were sufficiently paid to permit them to give up private practice entirely and to devote their whole time and strength to teaching and investigating in such hospitals." Time permits only the very briefest consideration of this proposition, with which I am in the fullest sympathy, and which for a long time, perhaps for twenty years or more, I have seriously debated. Certain objections may nevertheless, I believe, with great propriety be urged against prohibiting the acceptance of fees by professors of surgery in universities.

1. To be an impressive teacher of surgery, to attract important cases in large numbers, to exert an influence far and wide as a surgeon, to know his subject thoroughly, the surgeon must operate every day and always. A very considerable part of the surgeon's time must be spent in the operating room; more and more, it would seem, as time advances, for the number and variety of operations which a general surgeon performs each year is prodigiously increasing."

2. With a fixed salary the surgeon may devote himself to the work of his choice, whatever that may be. If his tendencies are in the direction of research, he will neglect his operative work; if he is a natural operator, he will chafe under the restrictions which prohibit the acceptance of fees so easily within his reach.

I know of one or two men to-day occupying important chairs of surgery in Germany, to whom operating is less agreeable than teaching, and whose clinics, in consequence, suffer greatly from want of surgical material. Billroth had comparatively and actually little operating to do when in the days of sepsis he was most earnestly engaged in his mi-

[18] Medicine and the Universities. An address delivered before the Western Alumni of the Johns Hopkins University, at the meeting in Chicago, Feb., 1902. American Medicine, July 26, 1902.

[19] Professor von Mikulicz writes me from Breslau "When I was a student in Vienna there were days, particularly in winter, when not a single operation occurred in the University clinic, so scarce was the operative material. To-day the number of cases for operation is so great in the large German clinics that even when operations are conducted simultaneously on two tables we find that three or more hours of intense work is required almost every day." Through the kindness of friends in Boston and New York I am able to append the reports which testify to the great increase in the number of operations performed in a year in the Massachusetts General, the Boston City, the Roosevelt and the New York Hospitals. The statistics furnished by the venerable Massachusetts General Hospital are particularly instructive. In the entire decennium prior to the discovery of anæsthesia only 385 operations were performed in the hospital, an average of 38.5 operations a year. In the first decade subsequent to the employment of ether 1893 operations were performed, an average of 189 per year. In the decade preceding Lister's visit (1876) to this country, from 1868 to 1878, 7696 operations were performed. In the next decade only 10,119 operations were performed in this hospital; but from 1894 to 1904, 24,270 were performed; and in the year 1903, over three thousand operations were performed in the Massachusetts General Hospital.

The other hospitals mentioned show an increase in similar proportions. It may surprise some that the decade following the introduction of antiseptic surgery, from 1878 to 1888, should show such a slight increase. This may be taken as an indication of what is true, viz., that the majority of the operations which are done to-day were not only not attempted, but were not known fifteen years ago. Indeed many of them were unthinkable before the introduction of antiseptic surgery.

Massachusetts General Hospital.

Number of operations performed in decade previous to discovery of ether 385.
Number of operations performed in decade subsequent to discovery of ether 1893.
Number of operations performed in decade previous to use of antiseptics in this country (1878) 7696.
Number of operations performed in decade subsequent to use of antiseptics 10,119.
Number of operations performed during last ten years (1894-1904) 24,270.
Number of operations performed during year 1903 3109.

Boston City Hospital.

In 1878 316 operations were performed.
From 1878 to 1887, inclusive, 5882 operations were performed.
From 1893 to 1902, inclusive, 16,269 operations were performed.
In 1902 1923 operations were performed.

Roosevelt Hospital, New York.

In 1878 132 operations were performed.
From 1878 to 1887, inclusive, 4060 operations were performed.
From 1894 to 1903, inclusive, 18,181 operations were performed.
In 1903 2719 operations were performed.
Operations in the Gynæcological division are included.

New York Hospital.

In 1878 142 operations were performed.
From 1878 to 1887, inclusive, 2706 operations were performed.
From 1894 to 1903, inclusive, 13,002 operations were performed.
In 1903 1680 operations were performed.

croscopical studies and laboratory pursuits; and Thiersch, although one of the greatest names in surgery, was not a great operator and had small operative material even for his day.

3. An able and successful surgeon probably would not for the sake of fame merely and the usual professor's or any feasible salary be content to operate so constantly and to incur the anxieties attendant upon a large surgical practice. Indeed, he probably could not relinquish all fees if he would, for the exigencies of his family and his tastes would prohibit his doing so. Young and comparatively untried men could, of course, be induced to take the position, and some of these would undoubtedly regret the compact.

4. Barker proposes, if necessary, to give the professors of the practical branches (technical professors we may call them) a larger salary than the others; but this would at once place the purely scientific men in an awkward position; it would pave the way for discontent among the chemists and physicists and others, who might with propriety claim that their salaries should be increased because they, too, might make a fortune if they were allowed to turn their ideas or discoveries to commercial account. As a matter of fact professors of chemistry and physics accept fees and all professors are at liberty to do so.

5. After all, the hospital, the operating room and the wards should be laboratories, laboratories of the highest order, and we know from experience that where this conception prevails not only is the cause of higher education and of medical science best served, but also the welfare of the patient is best promoted. It remains with the teachers of medicine and surgery to make them so. The surgeon and the physician should be equipped and should be expected to carry on work of research; they hold positions which should make them fertile in suggesting lines of investigation to their assistants and associates; they should not only be productive themselves, but should serve as a constant stimulus to others.

I should like to see the plan which Dr. Barker advocates carried out to the letter, and if it should succeed no one would rejoice more than I. But I would not advocate giving the surgeon or physician a larger salary than the others. The salaries of all must eventually be increased at least two or three-fold. There is, however, a compromise which even at present is altogether feasible. Let the surgeon be permitted to accept remuneration for services to certain patients operated upon in the hospital which the university provides or controls. His consultations and operations should all take place at the hospital. He might under only very exceptional circumstances be permitted to visit a patient in his town or State. Under special circumstances he might well be permitted to visit a patient in another State, if it were impossible for that patient to come to him. Private patients in a hospital need consume little or no more of the chief surgeon's time than the patients in the public wards.

While it has been my main purpose in this address to call attention to certain defects in the existing methods of medical education, especially in the opportunities for the advanced training of surgeons in this country, I would not be understood to minimize or to decry the great achievements of American surgery. Courage, ingenuity, dexterity, resourcefulness are such prominent characteristics of our countrymen that it would have been surprising if from the labors of her many earnest and devoted teachers and practitioners there had not resulted contributions to the science and art of surgery which have carried the fame of American surgery throughout the civilized world. The names of your own Nathan Smith and Jonathan Knight will always be treasured not only by this university, but wherever the history of surgery is cultivated. There is barely time for even the briefest reference to the recent contributions of America's surgeons to their art and science, but I should do my countrymen scant justice did I fail to emphasize the importance of at least one monumental contribution, which, I believe, redounds more to the glory of American surgery than any achievement of the past. It is hardly possible to overestimate the value of the modern work on the subject of appendicitis nor to attribute to it too great a share in stimulating and clearing the way for the great strides made in the entire field of abdominal surgery in the past twelve or fourteen years. It is convincing testimony to the advanced character of this epochal work that continental surgeons were for several years unable fully to comprehend and accept the teachings of their co-workers in the new country. As operators some of our surgeons are not surpassed by any I have seen; there are, I believe, few operations in surgery which cannot be performed as well in this country as anywhere in the world, and not a few operations are best performed by the surgeons of America.

A loyal son of Yale, I have rejoiced in the increasing prosperity of the Medical Department of Yale University during these recent years. Especially gratifying have been the manifestations of interest on the part of the University in the advancement of this Department and in general in the cause of higher medical education. I may be permitted to express my appreciation, and I believe I may add that of all concerned with these important problems, of President Hadley's valuable contributions to the discussion of this pressing topic.

It need hardly be said that the Yale Medical Department is hampered by inadequate resources. I am confident that during the past year no gift to the University has been more usefully and worthily bestowed than Mrs. Farnam's generous bequest to the Medical Department. With still larger additions to its endowment there is every reason to believe that the Yale Medical School will maintain a prominent position in the forward movement of medical education and research, and be one of the chief ornaments of this great university, receiving and conferring the stimulus of lofty ideals, of large achievements, of high renown.

NOTES SUGGESTED BY THE FRANKLIN-HEBERDEN PAMPHLET OF 1759.[1]

By Henry K. Cushing, M. D.,

Of Cleveland, Ohio.

In May, 1903, there was a sale of a large collection of most interesting documents, the so-called "Proud papers," at the book auction rooms of Davis & Harvey, Philadelphia. These had been preserved from early days by a line of eminent and far-seeing men, all Philadelphians but one, as materials for a history of their Province, and from these Robert Proud arranged and published "The History of Pennsylvania in North America."[2]

Since Proud's day this notable collection has come down, from generation to generation, in the line of a distinguished Philadelphian[3] of Colonial and Revolutionary days, intrusted to him for safe keeping, and as tradition rumors, in view of aid rendered in the straitened days of the publication of the History; and in this descent the collection has grown by valuable additions of early Americana.

From this sale the scribe of these notes secured the old pamphlet which has instigated them. In state and condition it is as perfect as when it left the press, and has gained that mellow hue time alone can tint.

It bears this title:

"SOME
ACCOUNT
OF THE SUCCESS OF
INOCULATION
FOR THE
SMALL POX
IN
ENGLAND AND AMERICA,
TOGETHER WITH
PLAIN INSTRUCTIONS,
BY WHICH ANY PERSON MAY BE ENABLED TO PERFORM THE OPERATION
AND CONDUCT THE PATIENT THROUGH THE DISTEMPER.
LONDON.
PRINTED BY W. STRAHAN, M. D. CCLIX."

This pamphlet had two authors, in each of whom there is reason to be interested. "The account of the Success of Inoculation in America" bears the simple signature, B. Franklin, of Philadelphia. Franklin was in the second year of his second residence in London, not an unknown journeyman printer, but the representative of the goodly Colony of Pennsylvania, Counselor at large of the American Colonies, high in the esteem of the wise and great of two continents.

This is his preface.

"London, Feb. 16, 1759. Having been desired by my esteemed friend Dr. William Heberden, F. R. S., one of the principal physicians of this city, to communicate what account I had of the success of inoculation in Boston, New England, I some time since wrote and sent him the following paper."

This "paper" fills four pages of the printed pamphlet: the contribution of his fellow author, Dr. Heberden, the eight succeeding pages.

In the Heberden preface is this statement, "Printed at the expense of the author, to be given away in America." William Strahan, the printer, was a little later Printer to the King, Member of Parliament, the old and constant friend of Dr. Samuel Johnson, according to Boswell, and intimate business and personal friend of Benjamin Franklin of long duration.[4]

William Heberden was the best classical scholar of his day, one of the group of great London doctors, friends and intimates of their American Associate F. R. S. for Franklin as you know was a Fellow.[5]

Heberden was one of the medical friends of Dr. Johnson, who once characterized him as "Ultimum Romanorum," the last of the learned physicians.

I do not find this philanthropic waif mentioned in Henry Stevens' abounding Bibliotheca Americana, or in Sparks', Bigelow's, Parton's or other biographies of Franklin at my command. A note but recently received from the Librarian at the British Museum reports that there is no copy in its library, neither is there one in the Congressional Library, or in that of the noted Boston Medical Library Association.

The Boston Public Library has a copy, as I learn from its catalogue of 1883, of books relating to Franklin in its possession. A note in this catalogue relates that in the Mass. Hist. Soc. Collections,[6] a reproduction of this pamphlet was published in 1816, through the instigation of Dr. John Farmer.

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[1] Read before the Johns Hopkins Hospital Historical Club, May 23, 1904.

[2] Printed in Philadelphia, vol. i appeared in 1797; vol. ii in 1798.

[3] Philip Syng Physick, M. D. "Mr. Physick placed his son when eleven years of age in the Academy belonging to the Society of Friends in South Fourth St. under the tuition of Robert Proud."

Memoir of the life and character of Philip Syng Physick, M. D. By I. Randolph, M. D., 1839.

[4] Franklin's letter to Strahan from Philadelphia in 1746.

[5] He was made F. R. S. April 29, 1756. "As an additional mark of honor, by vote of the Council, he was relieved from the payment of all fees; and it was ordered that he was to receive the Transactions without cost."—Franklin Cronology.

Three years before, 1753, the R. S. had awarded him the Copley Gold Medal for his electrical discoveries.

[6] Vol. ii, p. 7.

This is his note to the editor.

"AMHERST, N. H., Oct., 1816.

REV. SIR.—At this time I send you an account of the Success of Inoculation in Boston, written by Dr. Franklin to Dr. Heberden, in London. I have transcribed it from a pamphlet printed in London in 1759. With much respect

Your obedient servant

JOHN FARMER.

REV. DR. HOLMES."

The Rev. Dr. Holmes, of the Mass. Hist. Soc., was the Rev. Abiel Holmes, long minister of the First Church in Cambridge, author of the History of America from the discovery in 1492 to 1806, and father of Oliver Wendell Holmes. Thus 57 years after the issue of the pamphlet from the press in London, and eighty-eight years ago, a copy was sent for publication in Franklin's natal town as a rarity and subject of historical interest.

Paul Leicester Ford, in his useful Bibliography of Benjamin Franklin, quotes the pamphlet but ascribes the "Instructions" to Dr. Archer, instead of Dr. Heberden. Dr. Archer was physician to the London Small pox hospital at the time, and was mentioned by name in the "Instructions," from whence probably arose Ford's misconception.

Dr. Packard[7] reproduces Franklin's portion of the pamphlet with this approval . . . "Which is of such interest and presents such a common sense view of the status of the practice of inoculation at that time that I reprint it in its entirety."

The Surgeon General's Library, Washington, that of the Academy of Medicine, New York, of the Mass. Hist. Soc., Boston, and of the College of Physicians, Philadelphia, are fortunate owners each of a copy, making, with the subject of these notes six, and all I have been able to locate.

How many copies of this brochure were printed by Dr. Heberden I do not know, but presumably but a few hundred, and these, like New England Primers, and Poor Richard's Almanacs, published for years by tens of thousands, have few known survivors.

Franklin does state that Heberden "printed a very large impression of them," but 500 would seem to me a large impression for those days.

Dr. Packard informs me that he has 5000 in mind as the true number, but cannot recall his authority.

One would like to know how they were disseminated, of their reception and their influence. Primarily would they not have come into the hands of preachers, many of whom were practitioners as well, of doctors, of town clerks, usually men of more attainments than most of their fellows, and of postmasters, for Franklin had now been Deputy Post-Master General of the Continental Colonies for six years?

From Proud's History I take this instance of the then ever-present imminence of small pox, and of the acquired equanimity with which it was endured as one of the accompaniments of life sooner or later to be reckoned with.

"William Penn had for a considerable time past been making preparation for his voyage to America, which being at last accomplished in the sixth month of the year 1682, accompanied by a number of his friends, he went on board the ship Welcome, of 300 tons, Robert Greenway, Commander, and on the 30th of the same month (it was August) he writ from the Downs a valedictory epistle.

"The number of passengers on the ship was about 100, mostly Quakers from Sussex, the proprietaire's place of abode. In this passage many of them were taken with the small pox, and about 30 of the number died. In this trying situation the acceptable company of William Penn is said to have been of singular advantage to them, and his kind advice and assistance during the passage, so that in the main they had a prosperous voyage."

Estimating the crew of such a ship at 20 men (a large estimate probably) making with the passengers 120 souls all told, the mortality of 30 would have been one in four of all on board.

But the passengers fared even worse for one-third of them died on the eight weeks' voyage, as the Welcome did not get within the Capes of the Delaware until the 24th of October.[8]

One of the Welcome's passengers was Dr. Griffith Owen, a Welsh Quaker, later one of Pennsylvania's eminent physicians.

His ministrations, however, seem not to have been thought worthy of mention beside the "acceptable company" of the great Proprietaire.

The high born and distinguished Lady Mary Wortley Montague had small pox in early life, and though she escaped pitting, yet suffered the permanent loss of her eyelashes, an unfortunate blemish to an otherwise lovely face. Her only brother, the young Lord Kingston, heir to the Kingston Dukedom, died of it.

We can appreciate the interest with which Lady Mary heard of, and made herself acquainted with, the subject of inoculation for the small pox while in her residence in Turkey.

As you know, the early history of inoculation is largely one of speculation and probability. In the early years of the 18th century intimations, through letters and reports, began to appear in Europe, that in the Levantine regions a method of inducing a mild form of small pox was practiced by the common folk.

As information developed it became known that in Hindustan, Central Asia, China, Arabia and Moslem portions of Africa the practice in somewhat varied form, had so long been followed that its early history had been lost.

As the subject became generally known and considered it was also found that in some parts of Great Britain and Europe a practice of inoculation had long been resorted to by the peasantry, usually under the name of buying the small pox, a designation also common for it in the Levant, and parts of Africa. The South of Wales, Pembrokeshire, parts of the Scottish Highlands and Islands, Auvergne and Perigord in France, and Naples and Pavia in Italy are

[7] History of Medicine in the United States, 1901, p. 108.

[8] Encyclopedia Britannica.

claimed, with seeming good reason, as seats of this practice.[9] The designation was due to the custom of offering gifts or compensation to the individual who was to furnish the desired variolous matter.

It is fairly supposable that in divers countries and localities, experience through centuries with small pox epidemics, had revealed to occasional acute observers here and there, that persons suffering the ill received through abrasions or wounds on the hands had a milder form, than when it was taken in the ordinary way of infection. Inducing the disease in imitation, in hope of securing a milder type, would seem a natural sequence of consideration and action. It was the custom of some of the eastern peoples to inoculate between the thumb and forefinger, which strongly suggests that they were simply copying the hint indicated by accidental infection through the hands.

In all those regions of Asia and Africa where sowing, engrafting or inoculating the small pox was practiced, the camel was domesticated and the milk generally used.

Dr. Jenner[10] refers to the traditionary accounts, handed down by the Arabian physicians, that the small pox was originally derived from the camel. Casual infection through the hands, in grooming or milking these beasts, may have given the original suggestion of perpetuating a milder type by artificial transmission, as a similar condition in Gloucestershire dairies put Jenner on his long series of investigations on the cow pox.

The communications of Europeans, sojourning in the Levant, concerning this procedure made little appreciable impress on the convictions of their home peoples. Of these communications the historic ones are those of Dr. Emanuelle Timoni Patavino, a Greek physician, graduate of Pavia and Oxford, resident in Constantinople early in the 18th century, who in 1713 wrote a relation of the subject to a London physician, Dr. John Woodward, who communicated it to the Royal Society; and that of Dr. Jacobus Pylarinus, a Venetian physician, dedicated to the English Consul at Smyrna, which reported the Byzantine method of inoculating. The two appeared simultaneously in Vol. XXIX of the Royal Transactions, in 1717.[11] (See Appendix, II, page 284.)

Lady Mary Wortley Montague courageously determined not only to adopt this oriental custom of the common people, but to impart to friends at home the knowledge she had gained.

To her influence and example, according to popular impression, "we are indebted for its introduction and adoption in England, and for its consequent diffusion through Christendom."[12] Lady Mary's first letter on the topic was to her friend Mary Chiswell, from Adrianople, April 1, 1717, O. S. She wrote: "The Small pox so fatal and general amongst us is here entirely harmless by the invention of ingrafting, which is the term they give it. There is a set of old women who make it their business to perform the operation every autumn when the heat is abated."[13]

"People send to one another to know if any of their family has a mind to have the small pox; they make parties for the purpose; and when they are met (commonly 15 or 16 together) the old woman comes with a nut shell of the matter of the best small pox."[14]

Her little son Edward, three years old, was soon after inoculated under the supervision of Mr. Maitland, surgeon to the British Ambassador, her husband, at the Ottoman Court.[15]

She inserted it so roughly and clumsily in the arm of the child that Mr. Maitland completed the operation in the other arm.

The Montague's returned to England in October, 1718, but only in April, 1721, two and one-half years later, was the daughter, born in Turkey, (four months old when the brother was inoculated) inoculated in London, also by Mr. Maitland. This was the first recorded example in Europe, outside of European Turkey.

The Princess Caroline, of Wales, having lost a daughter by small pox, and anxious to preserve her other children, though an intimate friend of Lady Mary's, was not fully at ease as to the safety of the operation.

The King, at her solicitation, pardoned six criminals who were willing to undergo the ordeal on those terms.[16]

They were inoculated at Newgate by Mr. Maitland, August 9th, 1721, four months later than Lady Mary's daughter. In further trial two groups of Charity children, one of six and one of five, were also successfully operated upon in the spring of 1722.

The Princess now influenced Sir Hans Sloane, the Court physician, to wait upon the King (George I), for his assent. His Majesty concurring, the Princesses Anne and Caroline were, on the 19th of April, 1722, inoculated, under the direction of Sir Hans, a year after the operation on Lady Mary's daughter. But 845 persons in all England, were inoculated in the eight years following the example given by Lady Mary, and of these 17 died, nearly one in fifty. Hence we may judge of the slow and struggling development of the practice, and that the operators had not yet attained to the supposedly safer ways of the oriental performers.

Even the learned Heberden, 30 years later, was in grave fault in his pamphlet directions.

He says "every one would desire to be inoculated from as healthy a person as he could, and then strangely adds, though I believe the health of the person from whom the matter in taken is of very little consequence; it is of none whether he

[9] Crookshank, Monroe on Small Pox, 1818.

[10] Baron's Life of Jenner, vol. i, p. 522.

[11] "Illustris, Preclaris atque Erudissimo Viro Wilhelmus Scherard, Dignissimo pro inclyta Natione Britannica Nunc Smirnis Consulo."

[12] Baron's Life of Edward Jenner, vol. i, p. 230.

[13] An old Greek woman, many years in the habit of engrafting, was employed to procure variolous matter from a suitable subject.

[14] Always taken from a child.

[15] Crookshank on Vaccination.

[16] It succeeded happily upon five of them, the sixth, it was found, had already had small pox.

had a good or bad sort, whether he had few or many." This contrasts badly with the old woman "who comes with a nut shell of the matter of the best small pox."

By 1740 the practice had become nearly obsolete in England, but favorable accounts coming from the West Indies and both Americas a new impetus was given it. The planters and other slave holding folk of the new world had largely adopted it to preserve their costly slave property from sickness, blindness and death from the scourge, so virulent with the dark skinned races.

The Carmelites, and Friars of other orders in Portuguese and Spanish America, had introduced the practice, with great advantage, in the Indian races.

In 1746 the small pox hospital of London was founded to extend the practice among the city poor, and to sequester them, while ill, from the people at large.

In 1754, the influential College of Physicians of London declared its full approbation of the practice, and in 1759 we have found large hearted Dr. Heberden invoking Franklin's aid, for in America, as well as in Great Britain and in much of Europe, there were broad regions where it had not been adopted.

In Franklin's account of inoculation prepared for Heberden he makes this statement:

"Notwithstanding the now uncontroverted success it does not seem to make that progress among the common people in America which was at first expected. Scruples of conscience weigh with many, . . . and if one parent or near relation is against it the other does not choose to inoculate a child without consent of all parties, lest in case of disastrous event perpetual blame should follow."

Franklin had much reason for thorough interest in all that concerned small pox, and in inoculation, its only known alleviation, beside that consideration his ever investigating mind would have compelled.

James Parton, in his life of Franklin, says:

"About the time Benjamin Franklin donned the apron of the prentice boy Lady Wortley Montague came home from Turkey with the secret of the inoculation for the small pox.

"Cotton Mather read all about it, theory and practice, in the Transactions of the Royal Society, which he received regularly and to which he sent contributions.[17] He warmly welcomed the perilous invention, as did his venerable father, Increase Mather. Through their great influence a trial of inoculation was made in 1721, and with such success, that of 285 inoculated in Massachusetts only six died.[18] Nevertheless a great clamor arose against it as there does against every valuable idea or scheme when it is first promulgated.

"The witty correspondents of the Courant, James Franklin's paper, . . . led the attack upon the new remedy, . . . The apprentice meanwhile set the types, worked at the press and carried about the papers never presuming to take part in the controversy, keenly as it must have interested him."

Parton devotes some pages to the stirring occasion, which moved the town to its depths, and might have made some mention, of Dr. Zabdiel Boylston, who alone of Boston's doctors dared to test the procedure, at Mather's prompting.

With the rather meagre information from the Royal Transactions, and in face of the most violent opposition, on the 27th of June, 1721, he inoculated his only son, about 15 years of age,[19] and a middle-aged negro man and child of the family servants, with complete success. This was but two months later than the inoculation of Lady Mary's daughter in London, and there is no evidence that it could have been known in, or had the least influence in introducing the practice in New England.

Thus the communication of Timoni and Pylarini issued in the August Transactions of the Royal Society, little heeded in Great Britain, bore noble fruit in New England, through the Mathers' zest for knowledge and usefulness.[20]

Dr. Boylston, 40 years old at this time, erudite and respected, became the victim of a general spirit of malice and persecution. He was reviled, assaulted in the streets; his house mobbed and repeatedly harried. Parties patrolled the town with halters ready to hang him on the first convenient tree. For 14 days, at one time, he was obliged to remain hidden in a secluded place, unknown to any of his family but his wife, while by day and night parties entered seeking him.

Even after the rancor of the multitude had in some measure subsided he ventured to visit his patients only at night, and in disguise.

Many of his fellow physicians were of his chief contemners, abetting the lawlessness rampant in the community. Dr. William Douglass, a resolute and accomplished man, a comparatively recent comer, was foremost among these, of whom it has been recorded "that he was always positive and sometimes accurate." Though deriding the proposal of inoculation, he claimed to have furnished Cotton Mather the authorities, on inoculation behind this contention.

In a tract Douglass published in 1730 he says: "The small pox spread in Boston in 1721, and the Rev. Dr. Cotton Mather having had the use of these papers from Dr. William Douglass (i. e. the writer of these notes) surreptitiously, without the knowledge of his informer, that he might have the honor of a new fangled notion, set an undaunted operator at work." All untrue, I presume, except the undesigned compliment to the intrepid Dr. Boylston. Gov. Thomas Hutchinson,[21] last Colonial Governor of Massachusetts, relates some things of interest in this connection. "In 1721 the

[17] Packard Hist. of Medicine in the U. S., p. 24, says: "Cotton Mather was a member of the Royal Society."

[18] These were all inoculated within a year's time, and all in the three towns, Boston, Cambridge and Roxbury. Dr. Boylston inoculated 247, Drs. Robey and Thompson 39, or one-third as many as were inoculated in all England in eight years.

[19] Age variously stated from 4 to 15.

[20] Dr. Holmes says: "Set this good hint of Cotton Mather against that letter of his to John Richards, recommending the search after witch marks, and the application of the water-ordeal, which means, throw your grandmother into the water if she has a mole on her arm; if she swims, she is a witch and must be hung; if she sinks, the Lord have mercy on her soul."—O. W. Holmes, The Med. Prof. in Mass.

[21] History of Mass.

small pox made great havoc in Boston and neighboring towns, brought into the harbor about the middle of April by the Saltortugas fleet."

Having been prevented spreading for near 20 years before, all born within that time, with those who had escaped it before were liable to the distemper.".

Inoculation was introduced upon the occasion contrary to the minds of the inhabitant in general, and not without hazard to the lives of those who promoted it from the rage of the people. Dr. C. Mather, one of the principal ministers of Boston, had observed in the Philosophical transactions, letters . . . giving a very favorable account of the operation, and recommending a trial to the physicians of the town when small pox first began to spread, but they all declined it except Dr. Boylston, who made himself very obnoxious. Many sober, pious people were struck with horror, and were of opinion that if any of his patients should die he ought to be treated as a murderer."

The aged Increase Mather (82 years) issued an address to the public in the hope of enlightening general opinion. In tone and character it was most temperate and reasonable He wrote:

"It has been questioned whether inoculating the small pox be a lawful practice.

"I incline in the affirmative because I have read that in Smyrna, Constantinople and other places thousands of lives have been saved by inoculation, and not one of thousands have miscarried by it.

"This is related by wise and learned men who would not have imposed on the world a false matter.

"Therefore a great regard is due to it. . . And we have an army of Africans among ourselves who have themselves been under it, and give us all the assurance which a rational mind can desire that it has been used in Africa."

Cotton Mather, too, says:

"I was first informed of it by a Garamantee[34] servant of my own long before I knew that any European or Asiatic had the least acquaintance with it, and some years before I was enriched with the communications of the learned foreigners whose accounts I found agreeing with what I had received from my servant when he showed me the scar of the wounds made for the operation, and said that no person ever died of the small pox in his country who had the courage to use it.

"I have since met with a considerable number of those Africans who all agree in one story; that in their country grandy many dy of small pox; but now since they know this way, people take juice of small pox, and cutty skin and put in a drop; then by-nby a little sicky, sicky! then few little things like small pox; and nobody dy of it; and nobody have small pox any more."[35]

May not here lie the explanation of the Mathers' putting ready faith in what, but for this long known testimony of their African servants, would have seemed but an heathen legend strongly flavored with witch-craft or diablerie.

Dr. Boylston was a zealous botanist and naturalist and corresponded with Sir Hans Sloane, President of the Royal Society, before these days of stress due to inoculation. In 1723, on the invitation of Sir Hans, Dr. Boylston went to London, where he seems to have remained two or three years. He was received by the King, Geo. I,—prepared a dissertation on inoculation, dedicated to Princess Caroline, and published by the Royal Society, of which he was made a Fellow, and was presented by the King with 1000 guineas in token of the Royal appreciation of his services and influence in the cause of inoculation.

On page 29 of the "Many Sided Franklin" is reproduced, in fac simile, the notice which appeared in the Pennsylvania Gazette, Benjamin Franklin's own paper under date of Dec. 1736, in Franklin's 30th year.

"Understanding tis a current report that my son Francis, who died lately of the small pox, had it by inoculation; and being desired to gratify the public in that particular; inasmuch as some people are by that report . . . deterred from having that operation performed on their children, I do hereby sincerely declare that he was not inoculated but received the Distemper in the common way of infection; and I suppose the Report could only arise from its being my known opinion that Inoculation was a safe and beneficial Practice; and from my having said among my acquaintances that I intended to have my child inoculated as soon as he should have received sufficient strength from a flux with which he had long been afflicted."—B. Franklin.

Franklin afterwards wrote "I long regretted him bitterly, and still regret I had not given him the disease by Inoculation." For the remainder of his long life everything connected with small pox and inoculation must have clung closely to his remembrance and reflections. Franklin died early in 1790. The immortal Jenner had been zealously engaged for years in the elucidation of a safer and simpler remedy for the great distemper, under difficulties, discouragements and scepticism sufficient to have dazed one not of heroic mould.

In 1797 Jenner presented to the Royal Society, of which he was a Fellow, a manuscript giving the result of his researches and experiments, with the modest title of

"AN
INQUIRY
INTO
THE NATURAL HISTORY OF A
DISEASE KNOWN IN GLOUCESTERSHIRE
BY THE NAME OF THE COW-POX."[36]

The Council of the Royal Society declined to recommend it for publication, intimating that it would entail the loss

[34] Vessels salt laden from the Tortugas.

[35] According to the records of the selectmen of Boston, of 5889 who took it in the city, 884 died, about one in seven. Boston had the year before, but 11,000 inhabitants, so that more than one-half of them must have participated in the epidemic as sufferers.

[34] Garamantez, a country between the western end of the Saraha and the Atlantic coast.

[35] The Medical Profession in Massachusetts, O. W. Holmes.

[36] The manuscript, with some letters of John Hunter to Dr. Jenner, were given to Sir James Paget, in 1877, by a lady who had received them by will from her cousin, Colonel Jenner, son of Dr. Jenner. In 1879 Sir James Paget gave them to the library of the R. C. S. of London.

of such scientific repute as he then possessed gained through previous publications in that body."

In June the next year, 1798, he published himself in small quarto form a pamphlet of some 70 pages, giving the matured results of his researches and experiments, with a somewhat more elaborate title than that of the manuscript declined by the Council of the Royal Society, to-wit:

"AN
INQUIRY
INTO
THE CAUSE AND EFFECTS
OF
THE VARIOLAE VACCINIAE,
A DISEASE
DISCOVERED IN SOME OF THE WESTERN COUNTIES OF ENGLAND,
PARTICULARLY
GLOUCESTERSHIRE,
AND KNOWN BY THE NAME OF
THE COW-POX.
BY EDWARD JENNER, M. D., F. R. S., ETC."

It was dedicated to his friend, C. H. Parry, M. D., at Bath.

In the succeeding year, 1799, a second edition was published, dedicated to the King.

With what interest would Franklin have welcomed the knowledge of Jenner's researches on inoculation with the cow pox, or vaccination as commonly known, if he had survived, in whole mind, to that date but eight years only after his death.

He was a Bible student, a great admirer of its impressive English, and well acquainted with its contents. If the opportunity had been of his forecasting the result of Jenner's devoted work, might he not have recalled Numbers xvi, 48, where it is recorded of Aaron, "and he stood between the dead and the living and the plague was staid."

APPENDIX I.

BENJAMIN FRANKLIN'S LETTER.

SOME
ACCOUNT
OF THE SUCCESS OF
INOCULATION
FOR THE
SMALL-POX
IN
ENGLAND AND AMERICA.
TOGETHER WITH
PLAIN INSTRUCTIONS,
BY WHICH ANY PERSON MAY BE ENABLED TO PERFORM THE OPERATION, AND CONDUCT THE PATIENT THROUGH THE DISTEMPER.

LONDON:
PRINTED BY W. STRAHAN, M. DCC. LIX.

[*] The original manuscript is now in the Library of the Royal College of Surgeons, London, Crookshank, Vol. I, p. viii.

LONDON, Feb. 16, 1759.

Having been desired by my greatly esteemed friend, Dr. William Heberden, F. R. S., one of the principal Physicians of this city, to communicate what account I had of the success of Inoculation in Boston, New-England, I some time since wrote and sent to him the following paper, viz.:

About 1753 or 54, the small-pox made its appearance in Boston, New-England. It had not spread in the town for many years before, so that there were a great number of the inhabitants to have it. At first, endeavors were used to prevent its spreading, by removing the sick, or guarding the houses in which they were; and with the same view Inoculation was forbidden; but when it was found that these endeavors were fruitless, the distemper breaking out in different quarters of the town, and increasing, Inoculation was then permitted.

Upon this, all that inclined to Inoculation for themselves or families hurried into it precipitately, fearing the infection might otherwise be taken in the common way; the numbers inoculated in every neighborhood spread the infection likewise more speedily among those who did not chuse Inoculation; so that in a few months the distemper went thro' the town, and was extinct; and the trade of the town suffered only a short interruption, compar'd with what had been usual in former times, the country people during the seasons of that sickness fearing all intercourse with the town.

As the practice of Inoculation always divided people into parties, some contending warmly for it, and others as strongly against it; the latter asserting that the advantages pretended were imaginary, and that the Surgeons, from views of interest, conceel'd or diminish'd the true number of deaths occasion'd by Inoculation, and magnify'd the number of those who died of the Small-pox in the common way: It was resolved by the Magistrates of the town, to cause a strict and impartial enquiry to be made by the Constables of each ward, who were to give in their returns upon oath; and that the enquiry might be made more strictly and impartially, some of the partisans for and against the practice were join'd as assistants to the officers, and accompany'd them in their progress through the wards from house to house. Their several returns being received, and summed up together, the numbers turn'd out as follows,

Had the Small-pox in the common way.		Of these died.		Received the distemper by Inoculation		Of these died.	
Whites.	Blacks.	Whites.	Blacks.	Whites.	Blacks.	Whites.	Blacks.
5059	485	452	62	1974	199	23	7

It appeared by this account that the deaths of persons inoculated, were more in proportion at this time than had been formerly observed, being something more than one in a hundred. The favourers of Inoculation however would not allow that this was owing to any error in the former accounts, but rather to the Inoculating at this time many unfit subjects, partly through the impatience of people who would not wait the necessary preparation, lest they should take it in the common way; and partly from the importunity of parents prevailing with the Surgeons against their judgment and advice to inoculate weak children, labouring under other disorders; because the parents could not immediately remove them out of the way of the distemper, and thought they would at least stand a better chance by being inoculated than in taking the infection as they would probably do, in the common way.

The Surgeons and Physicians were also suddenly oppressed with the great hurry of business, which so hasty and general an Inoculation and spreading of the distemper in the common way must occasion, and probably could not so particularly attend to the circumstances of the patients offered for Inoculation.

Inoculation was first practiced by Dr. Boylstone in 1720.[28] It was not used before in any part of America, and not in Philadelphia till 1730. Some years since, an enquiry was made in Philadelphia of the several Surgeons and Physicians who had practis'd Inoculation, what numbers had been by each inoculated, and what was the success. The result of this enquiry was that upwards of 800 (I forget the exact number) had been inoculated at different times, and that only four of them had died. If this account was true, as I believe it was, the reason of greater success then than had been found in Boston, where the general loss by Inoculation used to be estimated at about one in 100, may probably be from this circumstance; that in Boston they always keep the distemper out as long as they can, so that when it comes, it finds a greater number of adult subjects than in Philadelphia, where since 1730 it has gone through the town once in four or five years, so that the greatest number of subjects for Inoculation must be under that age.

Notwithstanding the now uncontroverted success of Inoculation it does not seem to make that progress among the common people in America, which at first was expected. Scruples of conscience weigh with many concerning the lawfulness of the practice: And if one parent or near relation is against it, the other does not chuse to inoculate a child without free consent of all parties, lest in case of a disastrous event, perpetual blame should follow.

These scruples a sensible Clergy may in time remove. The expense of having the operation performed by a Surgeon weighs with others, for that has been pretty high in some parts of America; and when a common tradesman or artificer has a number in his family to have the distemper, it amounts to more money than he can well spare. Many of these, rather than own the true motive for declining Inoculation, join with the scrupulous in the cry against it, and influence others. A small pamphlet wrote in plain language by some skilful Physician, and publish'd, directing what preparations of the body should be used before the Inoculation of children, what precautions to avoid giving the infection at the same time in the common way, and how the operation is to be performed, the incisions dressed, the patient treated, and on the appearance of what symptoms a Physician is to be called, &c., might, by encouraging parents to inoculate their own children, be a means of removing that objection of the expense, render the practice much more general, and thereby save the lives of thousands.

The Doctor, after perusing and considering the above, humanely took the trouble (tho' his extensive practice affords him scarce any time to spare) of writing the following Plain Instructions,[29] and generously at his own private expense, printed a very large impression of them, which was put into my hands to be distributed gratis in America. Not aiming at the prize which however is justly due to such disinterested benevolence, he has omitted his name; but as I thought the advice of a nameless Physician might possibly on that account be less regarded I have, without his knowledge, here divulged it. And I have prefixed to his small but valuable work these pages, containing the facts that have given rise to it; because facts generally have, as indeed they ought to have, great weight in persuading to the practice they favour. To these I may also add an account I have been favoured with by Dr. Archer, physician to the Small-pox Hospital here, viz.:

	PERSONS
There have been inoculated in this Hospital since its first institution to this day, Dec. 31, 1758...	1601
Of which number died	6
Patients who had the Small-pox in the common way in this Hospital, to the same day.....	3856
Of which number have died.....	1002

By this account it appears, that in the way of inoculation there has died but one patient in 267, whereas in the common way there has died more than one in four. The mortality indeed in the latter case appears to have been greater than usual, (one in seven, when the distemper is not very favourable, being reckoned the common loss in towns by the Small-pox, all ages and ranks taken together) but these patients were mostly adults, and were received, it is said, into the Hospital after great irregularities had been committed. By the Boston account it appears, that, Whites and Blacks taken together, but about one in eleven died in the common way, and the distemper then was therefore reckoned uncommonly favourable. I have also obtained from the Foundling Hospital (where all the children admitted, that had not had the Small-pox, are inoculated at the age five years) an account to this time of the success of that practice there, which stand thus, viz.

Inoculated, boys 162, girls 176, in all.....338
Of these died in Inoculation, only..... 2
An the death of one of these two was occasioned by a worm fever.

On the whole, if the chance was only as two to one in favour of the practice among children, would it not be sufficient to induce a tender parent to lay hold of the advantages?

But when it is so much greater, as it appears to be by these accounts (in some even as thirty to one) surely parents will no longer refuse to accept and thankfully use a discovery God in his mercy has been pleased to bless mankind with: whereby some check may now be put to the ravages that cruel disease has been accustomed to make, and the human species be again suffered to increase as it did before Small-pox made its appearance. This increase has indeed been more obstructed by that distemper than is usually imagin'd: For the loss of one in ten thereby is not merely the loss of so many persons, but the accumulated loss of all the children and children's children the deceased might have had, multiplied by successive generations.

B. Franklin,
of Philadelphia.

WILLIAM HEBERDEN'S INSTRUCTIONS.

PLAIN
INSTRUCTIONS
FOR
INOCULATION
IN THE
SMALL-POX;
BY WHICH ANY PERSON MAY BE ENABLED TO PERFORM THE OPERATION, AND CONDUCT THE PATIENT THROUGH THE DISTEMPER.

LONDON:
PRINTED AT THE EXPENCE OF THE AUTHOR, TO BE GIVEN AWAY IN AMERICA.
M. DCC. LIX.

Introduction.

Inoculation, as I am well assured, would be much more general among the English on the Continent of America and of course many lives would be saved, if all, who are desirous of being inoculated, could easily be furnished with the means of having it done.

This consideration has engaged me to draw up a few short and

[28] The year was 1721.

[29] To make them the plainer and more generally intelligible, the Doctor purposely avoided, as much as possible, the medical terms and expressions us'd by Physicians in their writings.

plain instructions, by which any person may be enabled to perform the operation in a tolerable manner and to conduct the patient through the distemper in those places where it is not easy to procure the assistance of physicians and surgeons; and this practice has so greatly the advantage over every other way of communicating the Small-pox, that it would be the better to have inoculation performed by any body, or in any manner, than to suffer this disease to come on in the common way, though assisted with all the helps which art can afford.

PLAIN INSTRUCTIONS, &c.

OF THE SEASON OF THE YEAR PROPER FOR INOCULATION.

All seasons of the yeare are equally proper, as far as my experience goes; the bad sorts of Small-pox are not more common, or more fatal in hot or cold weather, than when the air is temperate. But as to the mild sorts, usually produced by inoculation, the extremes of weather in England are so far from bringing any danger, that they bring little or no inconvenience to the patients.

That the hottest weather is not too hot for inoculation is plain from this consideration, that it has been and is practised with success in the hottest of the English colonies in the West Indies. There is certainly this advantage attending hot weather, that it allows us to keep the doors or windows of the sick room open, whence arises such a constant renovation and purity of the air, as would, in my opinion, abundantly make amends for all the pretended inconveniences arising from heat, though they were much greater than have ever yet been supposed.

On the other hand, I know of no disadvantages attending winter which will not be sufficiently remedied by fires; and these too will help to make the air of the room constantly fresh.

If I was to make an objection against any season of the year (which I do not) it should be against the spring, though this has usually been chosen by inoculators; for it is in spring, more than in any other season, that many chronical and hereditary distempers are more particularly apt to make their appearance, and to be most troublesome.

OF THE AGE, CONSTITUTIONS, &c. OF THE PERSONS TO BE INOCULATED.

Children are very successfully inoculated at a month or six weeks old; and there is a particular advantage in their undergoing it while they are at the breast, as they make no difficulty of sucking; and the milk is the best food and physic which they can take. From the time of their being weaned to the tenth year, every year seems equally proper; only the longer it is delayed, the more danger will there be that the distemper may be catched in the common way. After the first ten years every year is, perhaps, better than the following one; though inoculation may always be practiced with great advantages over the other ways of receiving the small-pox at all ages, till we come to an age so advanced, that the consideration of the infection being perhaps less easily propagated among old people, joined with that of his having but little of life to lose, may make an old man not think it worth his while to submit to it.

It would be madness to inoculate one who was already laboring under some other acute (or violent) distemper. But as to sickly constitutions, and chronical or habitual disorders, I know none which heighten the danger of the Small-pox by having a particularly malignant influence upon it.

Many persons ill of venereal distempers, and others in the last stages of consumption, scrofulous and dropsical disorders, who have accidentally catch'd the Small-pox, have been observed to have it in the most favorable manner.

No one, therefore, ought to be discouraged from being inoculated merely on account of a weakly constitution, or because he is tainted with some hereditary or tedious distempers; unless they were so slight, or so dangerous as to make a probability that he might be cured, or would die before he would be in danger of catching the disease in the common way.

For such an one would receive as much benefit from inoculation as the healthiest person; nor, as far as I have seen, has he reason to fear more danger from it; care only should be taken to choose that time when he happens to be most free from his habitual complaints.

But though I see no reason to refuse the inoculating of such persons as I have been mentioning, yet there are others on whom no consideration whatever should tempt us to perform it, unless we can suppose an absolute certainty of their catching it in the common way; the persons I mean are breeding women.

There is a certain time in every month, during which it has been judged improper to inoculate women. This caution I find by experience to be useless; having known several inoculations at that time without any sort of inconvenience; nor is there any reason for contriving the inoculation so as that the courses shall not happen during the height of the distemper. Let them come when they will, they do no kind of harm, and seem of no consequence, and may be wholly disregarded. They are observed almost always to come on, even out of their regular course, at the eruption of the Small-pox, whenever the patient happens to be considerably full of it; I have talked with physicians who have thought this irregular appearance beneficial, but never heard of any who had reasons to think it hurtful.

OF THE PREPARATION.

Children under two years of age require no preparation; those who exceed this age, every other night for a fortnight before they are inoculated, should take four or more grains of rhubarb, or equal parts of rhubarb and jalap, so as to occasion one stool extraordinary the next day. If ever they had been used to drink any thing stronger than water, or very weak small beer, they must at this time be forbidden it; and they should eat meat only every other noon. As to their play and exercise without doors they may go on just as they used to do.

Such as are grown up may likewise be sufficiently prepared in a fortnight; during which they may be allowed to make half their dinner every day on meat; puddings, tarts, greens or roots, must make the other half. They should wholly abstain from all strong liquors, unless habit has made some absolutely necessary; and in this case they must do with as little as they can. Four such gentle purges should be taken in this time, as that each of them should occasion not above four or five motions. Bleeding is unnecessary. All great fatigue, and violent exercise should be forborn, together with all intense thinking, and application to perplexing business.

OF THE MANNER OF INOCULATING.

Every one would desire to be inoculated from as healthy a person as he could, though I believe the health of the person, from whom the matter is taken, is of very little consequence: it is of none, whether he has a good or bad sort, whether he has few or many.

The proper time for taking the matter is just before it would have dried up. In order to take it, any sort of thread must be had ready about the thickness of a common pin.

The head of one of the Small-pox may be opened with a needle, or pin, and then the thread is to be drawn along this, and other pocks, if it be necessary, till it is thoroughly wetted. The thread, thus wetted, may be put into a common pill-box, into which the air can easily get, and here it will soon become dry; you may either inoculate with it as soon as ever it is dry (and I advise it not to be used while it is wet) or you may then put it into a close box or vial, (for it will keep without spoiling after it has been dried) and use it some days after. It has been known

to keep its power of communicating the infection for many months. Half an inch of that part of the thread which has been well soaked in the matter, (and this will be known by its stiffness) must be cut off at the time of use. The person who is to be inoculated, must have the fine edge of a pen knife or lancet drawn along that part of the arm where issues are usually made; and it must go deep enough to make the blood just begin to appear; that is to say, the slightest incision which can be made is sufficient: this small wound should be a little more than half an inch long. In, or rather upon, this, the bit of thread must be put, and a small plaster of what is called the Ladies black sticking plaister, or a plaister of simple diachylon, is all which need be put over it to keep it on.

The inoculation may be performed in both arms for security's sake, least one of the plaisters should happen to come off; though if it were done in only one arm, I believe it would very rarely fail of success. If the person to be inoculated has an issue, the infected thread may be put into that without making any other incision.

Of the Management of the Patient after Inoculation.

After twenty-four hours the plaister and thread may be taken away; and from this time the incision need not be covered with any plaister, or roller, till it begins to inflame and grow sore; when for the ease of the patient it must be defended from the air, and from the rubbing of the cloaths by a bit of what is called in the shops The common plaister.

The inconvenience attending its being covered with any plaister or pultis after the first twenty-four hours is this, that these applications continued for four or five days will occasion a redness on the skins of many people, and in some will cause a considerable degree of erysipelatous (or tettery) eruption. At the time therefore when some appearance of the infection may be expected about the incision, it will be a little doubtful when a plaister has been applied, whether the discolouring and inflammation be owing to the expected distemper, or merely to the plaister. This will keep the patient and his attendants in an unnecessary suspense; and, if there should happen to be no eruption, their uncertainty would be much more perplexing, and might never be cleared up; whereas if such an inflammation came on four or five days after the incision, when no application had been used to the part, there could be no doubt of its arising from the infected thread; and it seems to be the general opinion in England, that a regular inflammation and suppuration of the little wound, proceeding from the infection of the variolous (or pocky) matter, will alone, without any eruption, fully secure the patient from having the Small-pox afterwards. Add to this, that there is not the least use in the applying of any thing to so slight an incision, till it begins to inflame and be sore.

After the plaister is applied, a fresh one may be put on once or twice every day.

If the inoculation should fail of communicating the infection, it may safely be repeated after waiting one month; for if it does not succeed, it does no harm, and the patient is just in the same state with those on whom it has never been attempted.

The inoculated persons may be allowed to go out every day, till the symptoms of the fever begin to come on; the confining them to their chambers immediately after the inoculation is performed, will have no good effect on their general health, and often a bad one on their spirits, and is not attended, as far as I know, with any advantage. But they must still observe the caution before mentioned, of avoiding all fatigue of body or mind. The diet may be the same as in the preparation; and, if the patient has not a stool every day, one drachm or more of kuritive electuary may be taken to procure one.

About the seventh day from the inoculation the patient generally begins to be heavy and languid, to feel weariness, headach, sickness, and the other forerunners of a fever; with all which he is so much oppressed as to find himself easiest in bed all the time that these symptoms continue, which is usually three days.

During this time barley-water, thin gellies, sage or balm tea, toast and water, thin gruel, milk-porridge, or some such liquor is commonly all which can be borne; and there is no occasion to press the patient to take any thing else; but if his stomach would bear he might be allowed almost whatever he would choose, meat and broth excepted.

Besides the complaints already mentioned, young children, just before the Small-pox appears, are apt to fall into convulsions; which seldom fail to occasion some alarm, though they are frequently forerunners of a favorable sort, and are very rarely attended with any real danger.

Troublesome as these symptoms are, it is not often that remedies are required for any of them, except the vomiting; and this is sometimes so continual as greatly to weaken the patient both by the fatigue of it, and by its hindering of him from taking any nourishment.

When this is the case, it will be found by experience that in the variolous (or small-pox) fever, as well as in other fevers, eight or ten grains of ipecacuanha will commonly check, if not entirely stop the vomiting, to the great relief of the patient.

They all vanish of themselves on the third day when the eruption (or breaking out) begins. After which the patient may either lie a-bed, or sit up, just as his strength and inclination prompt him. He must continue to abstain entirely from all liquors stronger than small beer, and from broth and meat of every kind; but may nourish himself with milk, panada, chocolate, Sago, gruels of all sorts, bread, biscuits, puddings, tarts, greens and roots. It will be right for him to drink frequently of some warm diluting liquors, such as thin milk porridge, whey, milk and water, balm or sage tea, toast and water, or warm water sweetened with preserved tamarinds, or any sort of syrup. It is still necessary, that he should have a stool every other day, and this may be commodiously procured, if there be occasion by a clyster of warm water only; a pint and a half will be sufficient for a grown person, and proportionately less for those who are younger.

As soon as the pocks are dry upon the face, the patient may be purged; and a gentle purge should be repeated every third day, till he has taken five. If he should have any cough or soreness of eyes, it will be necessary that he should lose some blood. After the first dose of physic he may begin to eat meat, and to take the air.

FINIS.

Appendix II.

From Pylarinus paper in the Philosophical Transactions, No. XXIX. 1717.

This medical operation which I am going to explain was not first discovered by the Improvers of Physic: but by a rude uncultivated People. It is not known who was the first inventor of it, but it is certain that it was first in vogue in Thessaly, in Greece, and hence, proceeding gradually through the neighboring countries and states, it at last arrived at the City of Byzantium, where it made very little noise for some years at first, and was seldom put in practice and only amongst the common people. But the small pox becoming lately very epidemical the method began to come more and more into practice, but still was never adopted by the people of rank and fashion till a certain Greek nobleman, of the ancient race of the Caryophille in the year 1701, toward the end of winter, asked me seriously what I thought of Inoculation, and whether he would advise me to try it upon his children, for at that time the distemper raged mortally all over the country. I told him I knew not what to say of an affair I was

so ignorant of being entirely unacquainted with the new methods, and at the same time desired leave to talk to some operators about it.

Three days afterward when I went to him again . . . presently there came a Greek woman into the room, who explained the whole operation; though she understood nothing of the true cause how the small pox is produced by inoculation. To all this she added experience and innumerable instances of its good success, some of which I had affirmed to me by people of the greatest veracity. She never inoculates except in winter; she is very nice in her choice of the pus for she will by no means take it promiscuously from every subject, but when the disease is epidemical, she takes the pus from ripe pustules of some girl of a good habit, and a favorable kind of pock, pricking it with a pin and squeezing it gently out, and putting into a little shell or glass which must be very clean and not too cold. This little vessel, well covered with a cloth, she puts into the bosom of her servant to be kept warm and as quickly as possible proceeds to the operation. She advizes the air of the room. Proceeding to the operation she pricks the middle of the forehead, the temples, at the roots of the hairs, and also the chin and both cheeks with a steel or, golden needle, spurting it in obligingly and separating the skin a little with the sharp point from the flesh below. Then with the same needle she introduces the pus into the little orifice, and ties a bandage upon the parts.

In the meantime the patient must lie moderately abed and not too much.

No wine or meat allowed until the 40th day.

VESICO-VAGINAL FISTULÆ FOLLOWING HYSTERECTOMY FOR CARCINOMA CERVICIS UTERI, WITH SPECIAL REFERENCE TO THEIR ORIGIN AND CLOSURE.

BY JOHN A. SAMPSON, M. D.,

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The relation between carcinoma cervices uteri and the bladder manifests itself clinically in the following ways:

First, the bladder wall may become involved in the anterior extension of the disease and with the necrosis of the cancerous tissue a vesico-vaginal fistula is formed.

Second, in the frequency of accidental injuries to the bladder in the operative treatment of this condition, there having been 19 such injuries in 158 hysterectomies for carcinoma cervicis uteri in this hospital.

Third, in the frequency of cystitis following the more radical operations for this disease, suggesting that the operation must be considered as an accessory etiological factor in its origin.

In removing the uterus with the parametrium on each side and a portion of the vagina, the bladder is deprived of these natural supports. Blood vessels and nerves going to the bladder are injured or destroyed, as well as similar structures within its walls.

From a study of the anatomical relation between the two organs it can be easily seen that the growth does not have to extend far in order to reach the bladder. The involvement of the bladder by the growth renders the separation of the two organs more difficult, and the surgeon who attempts to save the bladder which is adherent to a cancerous cervix, and at the same time remove the growth, usually fails in both, for the growth returns and the bladder wall is so injured in separating the two organs that either a vesico-vaginal fistula results or a severe cystitis develops because the injured bladder is unable to resist infection.

Cystitis is a most important post-operative complication in these cases on account of the danger of ascending renal infection. The lower ends of the ureters are very near the cervix and the growth does not have to extend far laterally either by direct invasion or by metastasis, to reach or extend beyond the ureters. Clinical experience and a study of the specimens removed by the more radical operations show that the tissue about the ureters should be removed in every instance.[1,2] There are two ways of accomplishing this, either to dissect the ureters free or else to excise the lower 3 to 4 cm. of the ureters with the cervix and implant the renal ends of the ureters in the bladder. If the ureters are dissected free[3,4] or reimplanted in the bladder, their function is temporarily impaired and the kidneys are placed in a condition of lowered resistance and an ascending infection[5] may occur.

Cystitis has occurred in 12 out of 16 cases in which I have followed the bladder conditions after these operations, resulting in ascending renal infection and death in two cases, in one of which the ureters had been resected but not in the other.

The important question arises, how may this post-operative cystitis be avoided? A retention catheter was tried in four cases, but cystitis occurred in all four cases, two of which resulted in ascending renal infection and death. The frequent catheterization of the bladder as a prophylactic measure, *i. e.*, every three to four hours, followed by bladder irrigations as recommended by Baisch,[6] has been tried in nine cases, but in all but one case cystitis occurred, as shown by cystoscopic examinations and taking urine cultures. I began this procedure before the work of Baisch appeared, and while it undoubtedly lessens the severity of the cystitis and so the danger of kidney infection, nevertheless, in my experience, it does not altogether prevent the cystitis. What shall be done in these cases? In three of four cases in which the bladder apparently escaped, an accidental vesico-vaginal fistula was present. In these cases there were no symptoms suggesting cystitis, and the bladder aside from the fistula appeared nor-

mal on cystoscopic examination. A patient may have a very marked cystitis, without any symptoms referable to it, as I have seen in some of these cases, where one would obtain cultures of the infective organism from the urine, pyuria would be present, and on cystoscopic examination the bladder mucosa would be "beefy red," covered here and there with a patchy white membrane; and yet the patient might be free from pain or other symptoms which could be referred to the cystitis.

We realize that the formation of a vesico-vaginal fistula our best means of treating severe cystitis, for it relieves the intravesical pressure and permits the bladder to rest. We are employing an old surgical principle for the treatment of infection in any part of the body, *i. e.*, incision and *free drainage*, together with rest of the part diseased; and apparently that is what a vesico-vaginal fistula *with free drainage* does for these cases. As I have written in a previous article,[7] "The excision of portions of the bladder adherent to the growth improves the chances of a cure and the presence of a vesico-vaginal fistula apparently lessens the severity of a post-operative cystitis and the dangers of an ascending renal infection."

It seems to me that the post-operative care of the bladder in these cases should be frequent catheterization, *i. e.*, every 3 to 4 hours, depending on the size of the bladder and the amount of urine excreted in that time. The patients should be catheterized with a two-way catheter and the bladder is irrigated with 200 cc. of sterile salt solution. Urine cultures should be taken at the end of the fourth or fifth day and later every week, and at the same time a cystoscopic examination should be made with the patient in the Sims posture.[8] If the cystitis is apparently mild, nothing further need be done, but if the urine becomes very cloudy and the bladder mucosa looks raw and a patchy membrane forms on the surface, then I think a vesico-vaginal opening should be made just posterior to the internal urethral orifice, and this can be accomplished and afterwards repaired without the use of an anesthetic, as has been described.[7]

Following these operations vesico-vaginal fistulæ may arise, some of which may be accidental and others intentional, the former being made either at the time of the operation in order to make a wide incision of the primary growth and the attempt to repair of the bladder being unsuccessful, or no attempt may have been made to repair it, which I think is especially desirable if the ureters have been resected or the bladder severely injured. A fistula may also have been made after the operation in order to freely drain and put at rest an inflamed bladder. In either instance we are dealing with a vesico-vaginal opening which may or may not close spontaneously.

I have reviewed the cases of hysterectomy for cancer of the uterus here in this hospital, in order to determine the immediate and final results of these cases in which a vesico-vaginal fistula has followed these operations.

Clinical Cases in which a Vesico-vaginal Fistula has followed Hysterectomy for Carcinoma Cervicis Uteri.

Case I.—Mrs. F. C. Age 53. Gyn. No. 1646. Gyn. Path. No. .0141.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, XI, 2, '92. Vaginal hysterectomy. Growth was very extensive and was probably not all removed.

Origin of vesico-vaginal fistula. Accidental; manifested itself by the escape of urine immediately after the operation.

Result. Two attempts to close the fistula were unsuccessful. Patient left the hospital five months after the first operation with the fistula unclosed. Vesico-vaginal fistula closed spontaneously in "a very short time after the patient returned home." Patient died about one year after the operation, from the cancer.

Case II.—Mrs. S. L. Age 38. Gyn. No. 2248. Gyn. Path. No. 62.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, X, 30, '93. Abdominal hysterectomy. Growth extensive and bladder was adherent.

Origin of vesico-vaginal fistula. Accidental; leakage of urine appeared on the third day.

Result. Patient discharged six weeks after operation with a vesico-vaginal fistula which persisted until death, ten months later, from cancer.

Case III.—Mrs. S. R. Age 55. Gyn. No. 6368. Gyn. Path. No. 2611.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, IX, 21, '98. Abdominal hysterectomy. Growth extensive and bladder was adherent.

Origin of vesico-vaginal fistula. Accidental; leakage of urine appeared immediately after operation.

Result. Fistula closed spontaneously one year after operation. Patient died from cancer two years and three months after operation.

Case IV.—Mrs. E. J. Age 46. Gyn. No. 7371. Gyn. Path. No. 3627.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, XI, 22, '99. Vaginal hysterectomy. Bladder involved by the growth.

Origin of vesico-vaginal fistula. Accidental; recognized at the time and repaired with catgut sutures. Unsuccessful.

Result. Fistula closed spontaneously eighteen days after operation. Patient died six months later, from cancer.

Case V.—Mrs. S. B. Age 40. Gyn. No. 7819. Gyn. Path. No. 4074.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, V, 17, '00. Abdominal hysterectomy. Growth extensive.

Origin of vesico-vaginal fistula. Accidental; date of detection of leakage not stated in history.

Result. Fistula closed spontaneously three months after operation. Patient died a "few months later, from general carcinosis."

Case VI.—Mfs. M. L. Age 44. Gyn. No. 7902. Gyn. Path. No. 4138.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, VI, 18,' 00. Combined abdominal and vaginal hysterectomy.

Origin of vesico-vaginal fistula. Accidental; leakage of urine discovered on the fourth day on starting the vaginal packs.

Result. Vesico-vaginal fistula persisted until death, seven months later, from cancer.

Case VII.—Mrs. E. W. Age 38. Gyn. No. 8577. Gyn. Path. No. 4827.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, V, 4, '01. Combined abdominal and vaginal hysterectomy.

Origin of vesico-vaginal fistula. Accidental; repaired with catgut sutures. Leakage of urine following operation.

Result. Fistula closed spontaneously before patient left hospital, V, 28, '01. Living and well May, 1904.

CASE VIII.—Mrs. F. B. Age 36. Gyn. No. 8711. Gyn. Path. No. 4907.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, V, 8, '01. Combined abdominal and vaginal hysterectomy. Extension of growth towards bladder.

Origin of vesico-vaginal fistula. Accidental; leakage of urine discovered on the fourth day, when the vaginal drains were started.

Result. Fistula closed spontaneously in three weeks. Unable to hear from.

CASE IX.—Mrs. J. K. Age 35. Gyn. No. 8733. Gyn. Path. No. 4939.

Diagnosis. Adeno-carcinoma cervicis uteri.

Operation, V, 8, '01. Combined abdominal and vaginal hysterectomy. Extension of growth towards bladder.

Origin of vesico-vaginal fistula. Accidental; recognized and repaired, but unsuccessful. Leakage of urine from the bladder discovered when the retention catheter, which had been placed in the blader at the time of the operation, was removed on the seventh day.

Result. Fistula persisted until death one year later, from cancer.

CASE X.—Mrs. H. J. Age 34. Gyn. No. 9074. Gyn. Path. No. 5232.

Diagnosis. Squamous cell carcinoma cervicis uteri. Pregnancy, four months.

Operation, X, 10, '01. Abdominal hysterectomy, an abortion having been done eighteen days before.

Origin of vesico-vaginal fistula. Accidental; recognized at the time and repaired with catgut sutures. Repair unsuccessful. Date of the appearance of the leakage of the urine not stated in the history of the patient.

Result. Fistula persisted until death, one year and five months afterwards, from cancer. No evidence of a return of the growth in the vaginal vault.

CASE XI.—Mrs. C. W. Age 40. Gyn. No. 9802. Gyn. Path. No. 6019.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, VII, 26, '02. Abdominal hysterectomy, with resection of the lower portion of right ureter, and implantation of the ureter into the bladder.

Origin of vesico-vaginal fistula. Accidental; closure with catgut sutures and fine silk. Leakage of urine discovered on the fourth day.

Result. Two attempts to close the fistula failed. A third was successful, two months after the operation. Patient living and well, V, '04.

CASE XII.—Mrs. V. K. Age 44. Gyn. No. 9903. Gyn. Path. No. 6103.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, IX, 17, '02. Abdominal hysterectomy with resection of the lower ends of both ureters and implantation of the renal ends into the bladder.

Origin of vesico-vaginal fistula. Probably accidental.

Result. Fistula closed spontaneously in about three months. Cancer returned

CASE XIII.—Mrs. S. F. Age 54. Gyn. No. 10,324. Gyn. Path. No. 6843.

Diagnosis. Squamous cell carcinoma cervicis uteri, with metastases to pelvic lymph node.

Operation, III, 18, '03. Abdominal hysterectomy.

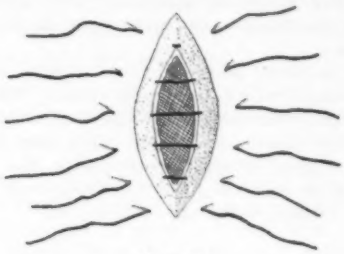

FIG. I.

FIG. II.

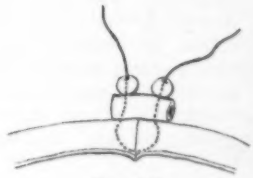

FIG. III.

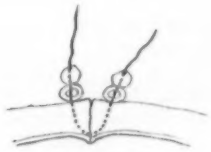

FIG. IV.

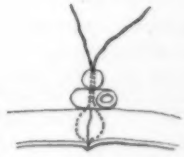

FIG. V.

FIG. I.—Represents the fistula with denuded edges and sutures in place.

The fistula has been lengthened, so that the approximation of the two sides will be more accurate.

The denudation is broad, thus giving a broad area of apposition.

The sutures should be about .5 cm. apart and extend down to but not through the bladder mucosa, and when brought together the bladder mucosa will be inverted. (See Figs. III, IV and V.)

FIG. II.—Cross section through fistula showing the form of the denudation and course of the suture.

The suture as shown passes down to the vesical mucosa and when brought together the bladder mucosa will be turned in.

FIG. III.—"Splinting" Suture.

Two needles were threaded with the ends of the suture and the needles passed through a small piece of rubber tubing, near enough together to approximate well the denuded fistula.

The tubing is held in place by two shot, one on each side of the suture. The elasticity of the tubing maintains the edges of the fistula in apposition without strangulating the tissue, and will take up any slack which may occur if the suture tears the tissue.

FIG. IV.—Another Form of Splinting Suture.

A small piece of tubing is placed in each end of the suture and held in place by a perforated shot. The elasticity of the tubing maintains apposition without strangulation.

This form of suture does not bring the vaginal surface of the fistula together quite as well as the one shown in Fig. III.

FIG. V.—Approximation Suture.

The two ends of the same suture are threaded into the same needle and after passing through the centre of a small piece of rubber tubing are fastened by a perforated shot.

This suture approximates the two surfaces well but has not the advantages of a splinting suture.

Origin of vesico-vaginal fistula. Accidental; convalescence slow. On the ninth day sudden rise in temperature reaching 104.8°. On pelvic examination there was found to be an accumulation of fluid posterior to the bladder, which proved to be urine, which had become encapsulated. This was opened and a large opening was found in the bladder, communicating with the encysted urine.

Result. Large fistula partially closed. Three further attempts to close the small fistula remaining, failed. Fistula persisted until the patient returned six months later, when the opening was successfully closed. In all the operations for the closure of the vesico-vaginal fistula, an anesthetic was not used, the previous operation apparently having rendered these parts insensible to pain. Patient living and well, VI, '04.

Case XIV.—Mrs. F. B. Age 39. Gyn. No. 10,627. Gyn. Path. No. 6885.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, VIII, 3, '03. Abdominal hysterectomy.

Origin of vesico-vaginal fistula. Accidental. Extension of growth towards bladder. Leakage of urine since operation.

Result. Two attempts at closing the fistula unsuccessful. Both without even a local anesthetic; bladder and vagina apparently insensible to pain. Fistula still present when last heard from, XII, '03.

Case XV.—Mrs. M. J. Age. 35. Gyn. No. 11,134. Gyn. Path. No. 7370.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, III, 31, '04. Abdominal hysterectomy.

Origin of vesico-vaginal fistula. Formed on the ninth day without the use of even a local anesthetic, in order to relieve cystitis. Making of fistula did not cause any pain. Patient did not know when it was done.

Result. Fistula successfully closed one month later. No pain, not even a local anesthetic used.

Case XVI.—Mrs. L. S. Age 37. Gyn. No. 11,234. Gyn. Path. No. 7468.

Diagnosis. Squamous cell carcinoma cervicis uteri.

Operation, V, 5, '04. Abdominal hysterectomy, with resection of the base of the bladder and reimplantation of the ureters into the bladder. The opening caused by the resection of the base of the bladder was filled in by the fundus of the bladder which was drawn down and sutured in place.

Origin of vesico-vaginal fistula. Fistula admitting small probe formed just posterior to the internal urethral orifice. Still present two months later.

There have been 16 instances of vesico-vaginal fistulæ following 158 hysterectomies for carcinoma cervicis uteri, of which 14 were accidental. Of these 14 accidental cases, 5 were recognized at the time of the operation and repaired, but the operation was unsuccessful. In 4 of the 5 cases catgut sutures were used, while in the fifth case the form of suture material was not stated in the description of the operation. In the other 9 cases the injury was not discovered until after the operation. In some cases the leakage of urine was noticed immediately after the operation, while in others it did not appear until later when the gauze drains were started, as on the third or fourth day; and in Case XIII an accumulation of urine occurred which was not recognized until it was opened on the ninth day, and thus a vesico-vaginal fistula was established.

I have been able to find in our records five other instances of injury to the bladder during hysterectomy for carcinoma of the cervix of the uterus, and two additional instances in which the bladder was injured, but the operation was abandoned because the growth was too extensive. In two of the five cases, Gyn. Nos. 3609 and 8387, the patients died as a result of the operation. In the first case there was a leakage of urine before death, the patient dying on the fourth day; in the second case the patient died within twenty-four hours. In both of the above cases the bladder was repaired with catgut sutures. In two of the other three cases the opening was repaired with catgut (Gyn. Nos. 5851 and 6685) and in the other case (Gyn. No. 2591) with fine silk; and in all three cases healing occurred without leakage. In the two cases in which the bladder was accidentally opened, but the operation had to be abandoned on account of the extent of the growth, the opening in the bladder was closed with catgut and no leakage occurred. In a few instances the bladder has been intentionally opened during hysterectomy for carcinoma cervicis uteri, either to determine the extent of the disease or to catheterize the ureters. These incisions have been closed either with catgut or fine silk and in some cases both forms of suture material were used. The only instances of accidental injury to the bladder, in hysterectomy for cancer of the cervix, where the injury has resulted in a vesico-vaginal fistula, which I have been able to find in our records, are the first fourteen cases previously referred to in this article. A study of these cases teaches us that the bladder is apt to be injured in hysterectomy for cancer of the uterus, and that while this injury may be recognized at the time and repaired, a vesico-vaginal fistula may result, as occurred in 5 out of 8 cases. On the other hand, the injury may not be recognized until afterwards, as occurred in 9 cases.

The Immediate Repair of Injuries to the Bladder during Hysterectomy for Carcinoma Cervicis Uteri.

The bladder has a good blood supply and usually it may be incised and the incision closed, and if care is taken healing will occur without leakage. When the bladder is injured in hysterectomy for carcinoma cervicis uteri it usually indicates that the growth has involved the bladder and that the difficulty in separating the two is responsible for the torn bladder. When this injury is repaired, one must close an opening in a portion of the bladder wall whose outer coats have been torn or partially removed and where the blood supply has been greatly injured, frequently so badly that healing of the repaired opening fails to occur and a fistula takes place, as occurred in 5 of the 8 cases previously referred to. In addition the dangers of leaving cancer tissue behind are great. If one wishes to repair these injuries successfully, it will be necessary to excise the portion of the injured bladder wall and suture together bladder tissue whose blood supply is good; and by so doing cancerous tissue will be removed in many instances.

We realize how frequently cystitis occurs in these cases and

that the lowered resistance of the bladder must in great measure be responsible for it, and this lowered local resistance is brought about by the removal of the natural support afforded to the bladder by the cervix and vagina. In addition the blood supply of the base of the bladder is injured by the ligation of vessels supplying vesical arteries and by the injury of vessels in the outer coats of the bladder and nerves are also destroyed. If the cervix is adherent to the bladder, then the injury to the bladder may be very great and after the operation the entire base of the bladder wall will be very thin and so injured that it will not only be unable to resist infection but its function will be so interfered with that it will be unable to contract. We realize that patients are usually unable to void urine immediately after these operations, and I attribute it to the large area of the bladder wall which must be thrown out of function by the operation, and not entirely to the destruction of nerves supplying the bladder; for in one instance where I resected the entire trigonum and made a new one by bringing the fundus down and suturing it to the internal urethral orifice, the patient was able to void urine spontaneously after the operation. In this case the area of bladder wall which is usually injured by the operation had been excised and healthy bladder tissue had been sutured in its place. It hardly seems justifiable to excise the entire base of the bladder in every case of carcinoma of the cervix, because one fears the operation may so injure the base of the bladder as not only to prevent the contractions of the bladder, but also, owing to its being a place of lowered resistance and becoming infected, to cause cystitis and thus expose the individual to the chance of an ascending renal infection; for in many instances the interference with the function of the bladder is only temporary and the cystitis is very mild. Nevertheless, in those cases in which the cervix is so adherent that the separation of it from the bladder must obviously so injure the portion of the bladder adherent to the cervix as both to greatly interfere with the function of the bladder and so cut off the blood supply of the portion of the bladder as to favor the occurrence of a severe cystitis, then it is best to excise this portion of the bladder; for afterwards a healthy bladder tissue can be brought together and the function of the bladder will not only be interfered with less and the dangers of cystitis minimized, but also there will be a wider excision of the primary growth and so a better chance for a permanent cure.

I think that fine black silk is a better suture material than catgut, and if care is taken to turn the bladder mucosa in there is very little danger of leakage, and one may expect a satisfactory closure in every instance.

The post-operative care of such cases has already been referred to. It requires frequent catheterization, *i. e.*, every 3 to 4 hours, depending on the capacity of the bladder and amount of urine excreted, followed by bladder irrigations of 200 cc. of sterile salt solution. I tried a retention catheter in four cases (in only one of which the bladder had been injured and repaired) and a severe cystitis occurred in all four cases, resulting in ascending renal infection and death in two cases. Against a retention catheter it may be said that it may fail to drain, due either to its having become occluded or being pushed too far in the bladder, in which latter case the bladder will have to be filled with urine before the fluid can reach the end of the catheter. In addition, the catheter acts as a foreign body in the bladder.

In some cases, it is best not to close the opening in the bladder entirely or else after the closure of the area of the bladder excised, to make another opening through the trigonum, where the drainage of the bladder can be best maintained, and also where the opening is more easily reached should it be necessary to close it later. The presence of a vesico-vaginal fistula seems to me to be especially indicated in those cases where there has been an extensive resection of portions of the bladder and also where the ureters have been resected and reimplanted in the bladder in order that the intra-vesical tension may be relieved and the bladder placed at rest.

THE CLOSURE OF VESICO-VAGINAL FISTULÆ FOLLOWING HYSTERECTOMY FOR CARCINOMA CERVICIS UTERI.

Two forms of vesico-vaginal fistulæ following these operations must be considered:

1. Those which are discovered after the operation or which result from the unsuccessful repair of injuries recognized at the time of the operation. In these cases the fistula is apt to be in a portion of the bladder wall whose blood supply has been injured and outer coats have been partially destroyed.

2. Those which have been purposely left open at the time of the operation or have been made afterwards to relieve cystitis, as has been described. These fistulæ should be surrounded by healthy bladder tissue.

In either case there is present a vesico-vaginal fistula which should be closed. A certain number of post-operative vesico-vaginal fistulæ will close spontaneously. This occurred in 7 of the 16 cases, 3 (Cases IV, VII and VIII) closing in three weeks, 2 (Cases V and XII) in three months, 1 (Case I) in six months, and another (Case III) at the end of a year. On the other hand, 4 cases persisted until the death of the individual at the end of seven months, ten months, one year, and a year and a half (Cases VI, II, IX and X). Three cases were successfully closed, one at the end of one month, first attempt (Case XV), another at the end of two months, after three attempts (Case XI), and another at the end of 6 months (Case XIII), after four failures. Of the other two cases one was still present six months after the operation (Case XIV), and another is still open two months after the operation (Case XVI).

It is evident that a vesico-vaginal fistula after it has served its purpose of relieving the intra-vesical pressure and resting the bladder, is very undesirable, especially if it exists for a long period of time. A spontaneous closure of the fistula is the easiest solution of the difficulty, but one does not care to wait six months or a year to have this accomplished, and many will never close spontaneously. It seems best if the

fistula is in a position where it will close spontaneously that it should be left to do so; on the other hand, a fistula, unless very small, situated near the center of the trigonum, where the closure of the vaginal walls can never reach it, is not apt to close, no matter how long one waits.

Certain difficulties present themselves in the closure of these fistulæ. The fistula is apt to be situated in bladder tissue which has been so injured by the operation that its blood supply is poor and healing is very difficult, and the attempt to close such a fistula immediately after the operation is apt to result in failure. In Case I two attempts to close the fistula failed; in Case XI the first two attempts failed, while the third, made eight weeks after the operation, was successful. In Case XIII four attempts made after the operation failed; on the other hand, the fistula was successfully closed six months later. In Case XIV three or four attempts made immediately after the operation failed, the fistula being still open six months afterwards. In Case XV the fistula was closed one month after making it (to relieve a cystitis). The fistula being in good bladder tissue, the closure was easy to accomplish. It seems to me that one should wait at least two months after the operation before attempting to close a vesico-vaginal fistula, for two reasons: first, the fistula may close spontaneously and the operation may be unnecessary; and second, the blood supply of the tissue will have time to be restored and the probability of a successful operation is assured.

Description of Operation for the Closure of Vesico-vaginal Fistulæ.

So much has been written about the closure of vesico-vaginal fistulæ that it seems almost useless to consider the subject again. Vesico-vaginal fistulæ vary in size, situation and the condition of the tissue in which they are situated; whether in healthy bladder tissue, or very thin tissue, or dense scar tissue, so that the operative treatment of this condition must be determined according to the demands of each individual case.

In order to successfully close vesico-vaginal fistulæ the following requirements are essential:

1. An approximation of the tissues without tension.
2. A broad area of denudation, exposing healthy tissue in such a manner that when the edges of the opening are brought together, the bladder mucosa will be inverted.
3. Accurate approximation with inversion of the bladder mucosa.
4. Tying the ligatures without strangulation of the tissue included in the ligature.

Failure to carefully observe any one of the above requirements is very apt to cause the operation to be unsuccessful.

Approximation without tension is most essential and this should be the first step in the operation. Unless this is accomplished the operation will surely fail and the fistula may be made larger instead of smaller by the operation. This may sometimes be accomplished by freeing the bladder, and by tension sutures, and in two instances of post-puerperal vesico-vaginal fistulæ, where the fistulæ involved the internal urethral orifice, I partially resected the urethra and *drawing up the freed urethra* reimplanted it into the opening in the bladder which had been made smaller in order to fit the end of the urethra. Some cases require multiple operations to cure the condition and many plastics have been devised to fill in the opening in the bladder where it has been impossible to bring the edges of the fistula together.

A broad area of denudation is also most essential, and this must be in healthy tissue or union will fail to occur and the sutures will cut through. In denuding the edges of the fistula, the denuded surface should slope from without inward so that when the edges of the fistula are approximated the vesical surface of the fistula will meet first and when the ligatures are tied the bladder mucosa will be inverted.

In order to assure an accurate approximation, the fistula should be converted into such an opening that the approximated edges will accurately fit each other. In order to do this it may be necessary to lengthen the fistula so that the two sides will meet at an acute angle and not in the form of a rounded border. The sutures should be placed the same distance apart upon the two sides and should go down to but not through the vesical mucosa, so that when tied the mucosa will be inverted, as shown in Figs. 1, 2 and 3.

Last, but not least, the sutures should be tied so as not to strangulate the tissue included within them. All other requirements may be fulfilled but this and if the sutures are tied too tightly the tissue will be killed and the wound break down and the operation fail.

I wish to describe a method of fastening the sutures, which apparently combines the advantages of a "splint" with that of a "suture" and approximates the edges of the wound without strangulation, and inverts the vesical mucosa. The suture material used is very fine silver wire, and the sutures are all passed as shown in Fig. 1, beginning 3 to 4 mm. back of the edge of the denuded area, going down to the bladder mucosa and then across the fistula, and entering the denuded area of the opposite side just beneath the bladder mucosa, and coming out in the vaginal mucosa at a point corresponding to the point of entrance of the needle on the other side. The sutures are fastened in the following way: Rubber tubing is used 3-5 mm. in diameter. That obtained from a male rubber catheter of that diameter has about the right consistency. This rubber tubing is cut into small pieces .5 to 1 cm. in length. If one wishes a "splinting" suture a needle is placed on each end of the wire suture and the needles are passed through a longer piece of rubber tubing, about .6 cm. apart. The rubber tubing is now pushed down the two wires and each wire is shotted, using just enough pressure on the tubing to slightly dent it (see Fig. 3). As can be seen, this suture serves as a splint; the edges of the fistula are approximated, and the elasticity of the pieces of rubber tubing maintains the approximation and prevents strangulation. If one wishes

an "approximation" suture only, a smaller piece of tubing may be used and both pieces of wire may be threaded in one needle, passed through the tube and fastened with one shot, as shown in Fig. 5. I have tried other methods of fastening the piece of tubing on the wire, one of which is to place a separate piece of tubing on each end of the wire, as shown in Fig. 4. This latter method of obtaining a "splinting" suture has the disadvantage that it does not approximate the vaginal surface of the fistula as well as the one first described unless the shot is pushed tightly down on the tubing, and when this is done the piece of tubing may become imbedded in the vaginal tissue. In most of the cases tried I have combined the "splinting" with the "approximation" suture, alternating the two, but I think that the form of suture first described meets all requirements.

I have used this method of closing vesico-vaginal fistulæ in eight cases, with only one failure. In three cases the fistula followed hysterectomy for cancer of the uterus. Cases XIII, XIV and XV of the cases reported in this article. In Case XIII the fistula was closed six months after the first operation. In case XIV the operation failed because the edges of the fistula were very thin and the tissue was in poor condition, and the attempt was made too soon after the first operation. Case XV, the fistula had been made to relieve a post-operative cystitis and was closed one month afterwards when the bladder condition had been relieved. This method was used successfully in the closure of four vesico-vaginal fistulæ which had been made to relieve a severe cystitis, Gyn. Nos. 10,579, 10,701½, 11,140 and 11,164, and also in the closure of one post-puerperal vesico-vaginal fistula, Gyn. No. 11,129, in which two previous attempts at another hospital had failed. I have used other suture material successfully in the closure of vesico-vaginal fistulæ, such as fine silk, silkworm gut and catgut, but prefer very fine silver wire, on account of its great pliability and aseptic qualities. I have also successfully closed vesico-vaginal fistulæ in other ways, as, in layers, using buried sutures of fine catgut and vaginal sutures of silkworm gut, Case XI in this article having been closed by this method.

Position.—Use the position best adapted to the individual case. In some, the dorsal position is very good, in others the best exposure may be obtained in the knee-breast posture. The position which I have found very serviceable is the lateral, left (Sims) or right, choosing the side giving the best exposure. If the hips are elevated one can usually combine many of the advantages of the knee-breast with those of the lateral, the vagina and bladder distending well, and the bleeding accumulating back in the vagina or flowing into the bladder, out of which it can be washed after the operation.

Post-operative Care.—The same care is used as in those cases where the bladder has been injured during operations and repaired. This consists in frequent catheterization with a two-way catheter followed by bladder irrigations. I think that the class of cases demanding the use of a retention catheter is very small and the disadvantages of the retention catheter have already been referred to.

Anesthetic.—The advantages of a general anesthetic lie in the increased amount of relaxation obtained and thus the better exposure and also the fact that the patient is unconscious of the operation. These factors make the task easier for the operator, and ensure better work. Against a local anesthetic such as cocaine it may be said that the local infiltration of the edge of the fistula distorts the tissue and interferes with the nicety of the operation, and the patient being conscious is not as relaxed as under a general anesthetic. I have closed vesico-vaginal fistulæ with cocaine as a local anesthetic, and although it can be done, the infiltration of the edge of the fistula with the solution interferes with the accuracy of the denudation and approximation of the denuded surfaces.

The Closure of Vesico-vaginal Fistulæ without an Anesthetic.

In various publications[1,2,3] I have called attention to the fact that these more radical operations apparently lessen the sensibility of the vagina so that the bladder may be opened and closed without pain to the patient; this is especially true if the opening is made in the bladder above the vagina, *i. e.*, in the portion of the base of the bladder exposed by the removal of the uterus and vaginal cuff. I have studied the sensitiveness of the vagina to pain in over 75 women, using a right-angle tenaculum or mouse-tooth forceps for the purpose, and found the vagina much less sensitive to pain than the vulva, which is very sensitive. There is great variation in different people. In some the vagina is relatively insensitive, so much so that portions of the vaginal mucosa may be excised, as in anterior and posterior colporrhaphies, with very little discomfort to the patient. In other cases pinching with forceps or sticking the vaginal mucosa with sharp instruments causes a great amount of pain. This is not dependent on the women having given birth to children, for I have found the vagina of some nullipara relatively insensitive and also the vagina of some multipara quite sensitive to pain. The practical bearing of this condition in these cases is that these operations render the vagina still less sensitive, so much so that the bladder may usually be opened and closed without hurting the patient. As most of the patients who suffer from cancer of the cervix have had children, the outlet is relaxed and a suitable exposure can usually be obtained, and thus the patient may be saved the dangers and discomforts of a general anesthetic and the local distortions of a local anesthetic may be avoided.

Conclusions.

I. The anatomical relation between the cervix and bladder is such that the anterior extension of carcinoma cervicis uteri soon invades the bladder wall, as shown by:

1. Vesico-vaginal fistulæ, which may occur in the advanced cases and result from the necrosis of the growth, which has invaded the bladder wall.

2. Accidental injuries to the bladder occurring during hysterectomy for cancer of the uterus.

3. Cystitis following these operations, demonstrating that the operation must be considered an accessory etiological factor in its origin.

II. The surgeon who attempts to separate a carcinomatous cervix which has become adherent to the bladder, usually:

1. Leaves cancer tissue behind, and the disease returns.

2. So injures the bladder wall that a vesico-vaginal fistula may form, which if recognized and repaired at the time, is apt to fail to unite, because the fistula is situated in a portion of the bladder wall whose outer coats have been torn and whose blood supply has been injured by the operation.

3. If he does not produce a fistula the injured portion of the bladder may be unable to resist infection and a severe cystitis may result.

III. On account of the above, *if the cervix is adherent to the bladder the portion of the bladder wall adherent should be excised*, in order:

1. That a wider excision of the primary growth may be obtained.

2. That the injured bladder wall may be repaired, for one may then unite healthy bladder tissue together and so feel assured of a successful repair of the injury.

3. That the bladder may be better able to resist infection, for the portion of the bladder weakened by the operation has been removed.

IV. Post-operative vesico-vaginal fistula may occur:

1. From undiscovered accidental injuries to the bladder or the failure of the repair of injuries recognized at the time of the operation.

2. From the intentional formation of such fistulæ at the time of the operation in order to relieve intra-vesical tension and give the bladder a rest, and also the formation of fistulæ after the operation in order to minimize the dangers of post-operative cystitis.

V. Frequently post-operative vesico-vaginal fistulæ close spontaneously. This may take place in a short time, as a few days or weeks, or may require as long a time as six months or a year; on the other hand, some will never close.

VI. Apparently the early operative closure of such fistulæ, unless in healthy bladder tissue, is difficult, and operative measures should not be undertaken until the tissue has had a chance to regain its natural blood supply. One should probably wait at least two months before undertaking such steps.

VII. The radical operations for cancer of the uterus diminish the sensibility of the vagina and bladder to pain, so that post-operative vesico-vaginal fistulæ may be closed without the use of a general or local anesthetic.

VIII. The following principles should be employed in the closure of these and all vesico-vaginal fistulæ.

1. Approximation without tension.

2. A broad area of denudation exposing healthy bladder tissue.

3. Accurate approximation with inversion of the bladder mucosa.

4. Tying the ligatures so as not to strangulate the tissue.

IX. Very fine silver wire fastened by means of perforated shot form a very satisfactory suture material, and if a small piece of rubber tubing is placed between the shot and the vaginal mucosa a most efficient "splinting" suture is formed, which, through the elasticity of the rubber tubing, maintains accurate approximation without strangulation.

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THE PIEZOMETER, AN INSTRUMENT FOR MEASURING RESISTANCES.

BY HOWARD A. KELLY, M. D.,

Baltimore.

I here exhibit a new instrument intended to register varying degrees of resistance, which, adopting the name already in use, I have called a *piezometer*. Its purpose is to substitute a simple, scientific, objective means of demonstrating pressure for the subjective methods, depending on the use of the fingers, which are now in use. The piezometer consists of a slender, graduated rod, about 30 cm. in length, divided into centimeters from its lower end up to a metal cylinder, about 13 mm. in diameter and 18½ cm. in length, in which the upper part of the rod is enclosed. This cylinder has a fenestrum about 10 cm. long, in which slides an indicator attached to the rod that when not in use is held at the lowest point, where it registers zero, by a well-tempered spring. The distance from the zero mark to the upper end of the fenestrum is graduated by hundreds up to two kilometers. On the rod, between the button at its lower end and the cylinder, a fenestrated wheel slides freely. The instrument is intended, as I said, to estimate varying degrees of resistance, and thus ascertain the amount of pressure necessary to elicit tenderness, while at the same time, by means of its wheel, it registers the depth of the depression made on the skin surface.

I am indebted to Dr. Emil Schmoll for calling my attention to the only instrument which, so far as I know, presents any points of similarity to the piezometer. It is the algesimeter of Boas (*Diagnostik und Therapie der Magenkrankheiten*, Leipzig, 1894, p. 75), a little instrument, about 10 cm. in length, consisting of a piston traveling in a cylinder with an indicator registering pressure from one-half kilo to ten kilos in amount, and intended to estimate the sensitiveness to pressure over the stomach and upper abdomen. It lacks any provision, however, for measuring the resistance of the abdominal wall, or the depression in the wall made by any given degree of pressure.

There are two ways of using the piezometer for the purpose of outlining an abdominal tumor. In the first place, a given degree of pressure, say 800 to 1000 grams, may be used, and the depth of the impression afforded by it noted, as registered by the wheel. So long as the pressure is made over a tumor, only a slight depression, say 1 to 1.5 cm. is registered, while as soon as the same degree of pressure is made over the soft parts of the abdomen, beyond the margin of the tumor, the tip of the rod sinks in as much as 2 cm. or more. This manner of using the instrument makes it possible not only to measure the degree of pressure made, but to demonstrate it to the bystanders, whereas, by simple palpation, although an experienced observer is able to appreciate the amount of pressure conveyed to the tips of his fingers, he establishes it in a purely subjective manner, and is able to give it expression in only a vague, if not an inaccurate manner.

The second purpose for which the piezometer can be used is that of estimating the degree of rigidity in the right iliac fossa in a doubtful appendicitis, by comparing the rigidity of the right and left oblique muscles. For example, with a pressure of 500, the button on the end of the rod may indent the abdominal wall so that the wheel registers 1 cm. (e. g.) on the right side, while, at a corresponding point on the left side, it registers 1½ or more. In this way the rigidity is demonstrated beyond a question, and no allowance need be made for difference in tactual sense. Again, the piezometer may be used as an algesimeter, simply to determine how much pressure is necessary to elicit tenderness over the appendix, while with the graduated rod and the wheel, the depth of the depression is estimated at the same time, which makes a much more satisfactory comparison. The piezometer should also have a field of special value in teaching physical diagnosis to classes, because, since it is far more delicate than the untrained sense of touch, varying degrees of resistance can be demonstrated by means of it, after which palpation can be employed in order to train the sense of touch.

Finally, let it be understood that the instrument is intended, not to replace the method of palpation, but to supplement or to confirm the results obtained by it.

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DR. RICHARD BROOKE, THE FIRST SCIENTIFIC OBSERVER IN MARYLAND.

By Bernard C. Steiner, Ph. D.,

Associate in History, Johns Hopkins University.

This pioneer title may well be given to Dr. Richard Brooke, son of Major Thomas Brooke and his wife Lucy (Smith) Brooke,[1] who was born near Nottingham, Prince George's County, Maryland, June 2, 1716, and died July 12, 1783. He graduated in medicine, with the degree of M. D., at an unknown university,[2] and practiced his profession in his native county. Marrying late in life, on Nov. 1, 1767, Rachel Gantt, daughter of Dr. Thomas and Rachel (Smith) Gantt, of Calvert County, he had two children: a son, Frederick Thomas, who was born July 27, 1770, and moved to West Virginia; and a daughter, Sarah, who married Samuel Harper, of Alexandria, Va. Mrs. Brooke died on June 28, 1793.

Dr. Brooke took an active part in politics and incurred the enmity of the Proprietary Governors by his opposition to their acts. Before 1750, he sent a memorial to the President of the Privy Council, "in which it is alleged" that Charles Lord Baltimore "did in a peculiar manner countenance and encourage the Roman Catholicks" in Maryland.[3] In a letter of April 19, 1761, Gov. Horatio Sharpe referred to this memorial and spoke of Dr. Brooke as a "flaming zealot against Papists and railer against the Lord Proprietary." Dr. Brooke is said to have made several voyages to England in the interests of the province, which voyages he refers to in his will. In this will he requests that the Legislature should see that its provisions were fairly executed, "in recognition of the services I have rendered and the large sums of money expended for my countrymen."[4]

Dr. Brooke was a contributor to the Philosophical Transactions[5] in London and to the Gentleman's Magazine, and wrote on medical and scientific as well as on political subjects. The first article found of which he was the author appeared in 1752, on "Inoculation without incision."[6]

In 1747, Dr. Brooke inoculated a young gentleman, then about 20 years of age, and made a slight incision on the biceps muscle, in which he laid the "lint impregnated with variolous matter." The bandage was too loose and the lint shifted from the wound, but Br. Brooke found that the "part, whereon the lint lay after its removal, was inflamed and full of red pimples," and the patient went "through the different stages of the disorder, without the least threatening symptom." Dr. Brooke then tried with great success among children to "convey the disorder without making an incision, but merely applying the infected lint to the arm and confining it with adhesive plaster." Apparently he did not try the plan with adults, but he suggests that, "though the density of the pores" may be too great in their case for such infection, yet friction may be used to make "the cuticle as thin as we please."

The Philosophical Transactions adds that Dr. Brooke's experiment was tried unsuccessfully on children in London.

In 1755 he sent to the Royal Society[7] a "Thermometric Account of the Weather" from September, 1753, to September, 1754. This is the first series of such observations extant, which were made in Maryland, and showed a yearly variation of 78° F., a monthly variation of 58° F., and a daily variation of 25°. He also took barometric observations, and in transmitting the record of his work to his friend, Dr. J. Bevis, of London, gave reasons for expecting a very severe winter, *e. g.*, there is an abundant crop of wild grapes, the summer has been "the wettest that is remembered by any man," the winter succeeding a hard one in Europe is apt to be severe in Maryland, and a warm autumn with southerly winds is apt to bring a cold winter. The year previous had no day of extreme heat or cold, so that the weather had been more like that in England than usual.

In the same letter, Dr. Brooke regrets that a ground hog, which he intended to send Dr. Bevis, had escaped after the three months that the animal was kept in the vain attempt to find a "captain of a ship that would take charge of him."

The letter also gives the intelligence that intermittent fevers have been very common that autumn, and though they yield to the bark, some patients, "after the fevers have left them," are affected with slight touches of a catalepsy, "which is worse at the full & the change of the moon."

In the succeeding February, Dr. Brooke wrote again, stating that his prognostications of a severe winter had proven correct and "that pains at the breast and bowels, spitting of blood and eruptive fevers, the two former diseases especially, have been very frequent." The "small pox have of late been for the most part favorable." He regrets exceedingly the

[1] Bowie's "Bowies and Their Kindred," 363.

[2] 25 Gent. Mag., 54.

[3] 2 Sharpe Correspondence, 501.

[4] "Bowies and Their Kindred," 363.

[5] Dr. Quinan discovered the articles in the Philosophical Transactions, and refers to them in Md. Med. Jour., June 23, 1883, and Dr. E. F. Cordell mentions them in his "Medical Annals of Maryland," pp. 650, 652, 653, 654. Mr. O. L. Fassig discusses Dr. Brooke's observations at some length in 3 Climate and Crop Service, Md. and Del. Section, No. 12, p. 3. (See also 1 Md. State Weather Service Reports 348.) In this article, he also discusses Dr. Brooke's observations from 1754-1757 referred to below. He reprints Dr. Brooke's meteorological papers in the Gentleman's Magazine in 9 Climate and Crop Service, Md. and Del. Section, No. 5, p. 3 and No. 6, p. 3.

[6] 47 Philosophical Transactions, 470.

[7] 51 Philosophical Transactions, 58; 25 Gent. Mag., 54.

failure of a bill at the last session of Parliament for establishing a "general bill of mortality throughout the nation," and trusts that such a bill may soon be passed, as one person can have little certainty "respecting the reigning diseases and the general influence of the weather upon them."

In 1756, he wrote[8] of a remarkable effect of a bolt of lightning, which struck the iron weather cock on the cupola of the brick house belonging to Mrs. Addison, "a widow lady in our neighborhood." He gives a cut of a form of lightning rod, which is used in Virginia, and asks whether such "are like to be dangerous or useful?"

In 1752, he had begun[9] contributing to the Gentleman's Magazine, sending a recipe to destroy lice in a child's hair by rubbing the powdered bark of sassafras root among the hair and tying up the head in a handkerchief over night, to prevent the powder from falling out. He also told of a cat at Mr. James Greenfield's, in Maryland, who gave suck to a young rat along with her kittens,[10] of the method of tanning leather in Maryland, and of his own successful experiment of preventing maggots swarming in cases of amputation by daily sprinkling wheat flour "over the pledget."

In a third article,[11] he told how he cured a young lady of a "pimple in the roof of her mouth about the bigness of a small pea." After failing "with gargles & doses of salts" for two months, he induced her to drink a draught of water every day, while previously she would not drink for seven days consecutively. The water cure was effectual.

In 1759, Dr. Brooke sent to the Royal Society a thermometric account of the weather for the three years, September, 1751, to December, 1754. The account is interspersed with accounts of the climatic and hygienic conditions of the province. The dry summer of 1755, an earthquake shock in the fall of that year and a tornado on June 22, 1756, are also chronicled. The last did incredible damage in several parts of the county, blew down 200 houses, killed "many people in St. Mary's County & extended as far as New York & Virginia."

In May and June, 1756, he observed an epidemical spotted fever, from which he heard of no deaths, and an epidemical disorder among dogs, in the nature of an epizootic. The disorder continued throughout the summer. In September, Dr. Brooke saw a tame fox very ill with this disease. He gave him a "dose of a valuable powder, with which I have done much good & for the knowledge of which I was indebted to my worthy friend, Dr. Parsons, when I was last in England. The powder had cured dogs, but the fox died within three minutes of the time of taking it, which death Dr. Brooke attributed to the punch, in which he gave the powder.

The summer of 1756 was the hottest and dryest ever known in Maryland, and "putrid bilious fevers" and an "hepatic dysentery" raged. Dr. Brooke gave Dr. Parsons' powders to his patients, in connection with an opiate (*pil. mathaei*) and a few doses of astringents, and had great success. Small pox and swine pox were also prevalent, but in a mild form. In December, Dr. Brooke fell ill, and so contined for twenty-seven days, suffering from a fever, cough, and "spasms of the muscle trapizeus," from which last complaint he found relief "by drinking punch, into which Goa Stone had been plentifully grated." In February, 1757, he encountered a disease among the negroes, beginning with "pains in their heads, necks, shoulders, breasts, or bellies," and usually developing into a "hard & sensible tumor" in the triceps muscle of the thigh. "There was a high fever during the time." "Emollient plasters would commonly remove the tumor in two days' time," but afterwards a tumor usually developed in the ham or calf of the leg, which tumor was generally "repelled" by the same "cataplasms & the patient would get well usually in about a fortnight." In one case, that of a negro boy, "the matter descended to the foot," which suppurated and was very hard to heal.

In April, 1757, Brooke found "impetiginous disorders common," and, in June and July, many were "troubled with imposthumations under the arm all in the *axilla dextra*." "Almost every patient, in whatever disorder, had more or less of bilious symptoms." Inflammations of the neck of the bladder were very common, but were "cured by anti-phlogistic medicines." In August and September he had a number of patients who "were taken with a violent pain in the *os frontis* on the left side. The pain soon fell into the eye on the same side and occasioned a dimness, but this and the pain were soon removed by an epispastic behind the ear, if applied early." In one case, "a negro wench" had had the the complaint so long that she was totally blind, but Dr. Brooke cured her by "caustics behind the ear & vitriollic collyricums." In October a pestilential fever raged among horses along the salt waters of the Chesapeake, but apparently did not affect those in forest pastures.

In the Maryland Gazette for Nov. 4, 1762, Dr. Brooke wrote advising that bleeding and mercury be used in cases of hydrophobia, and that the wound be scarified. A year later he sent a communication of some length to the Gentleman's Magazine,[12] setting forth his opposition to the Proprietary Government of Maryland. He claimed that property in the province was not secure, when such enormous powers were vested in the junto of the Proprietary and his officers. Nine of the twelve councillors enjoyed offices which amounted to near £4000 pounds sterling and so were partial to Lord Baltimore. The Legislature consisted of four parts, of which the Proprietary had three: himself, his Governor and his Council. The Upper House, or Council, had rejected the Lower House's bill that there be a Provincial Agent in England, but Cecilius Calvert, Lord Baltimore's uncle and agent, represented the Proprietor and not the province, and so the desired

[8] 26 Gent. Mag., 32.
[9] 22 Gent. Mag., 182.
[10] 22 Gent. Mag., 208.
[11] 22 Gent. Mag., 278.
[12] 33 Gent. Mag., 541.
[13] 51 Philosophical Transactions, 70.

position was not filled. The Governor was also the Chancellor, the Governor and the Council were the Court of Appeals from the Chancery Court. Some of the members of Council were clerks of courts and yet they presided as judges of the Provincial Court on appeals from the county judges. All judges held their commissions at the Proprietary's pleasure. Surely this was not a free government nor fit for Englishmen. Such is a brief outline of his cogent argument. At the opening of the American Revolution Dr. Brooke warmly supported the patriotic side, was a member of Convention in July, 1775, and signed the well-known Association of the Freemen of Maryland.[34]

These are but a few scattered notes concerning a useful man. He was the first known scientific observer in Maryland, the first medical man in the State to publish an account of his practice, and was one of the early physicians to be interested in politics, serving his State in public as well as in private ways, in which course he has had many successors down to the present day.

NOTES ON NEW BOOKS.

The Practical Study of Malaria and Other Blood Parasites. By J. W. W. Stephens, M. D., and S. R. Christophers, M. B., Members of the Royal Society's Commission on Malaria in Africa and India, 1898-1902. (*Published for the University Press of Liverpool, by Longmans, Green & Co., London, New York and Bombay. 1903.*)

The book is essentially a convenient epitome of the results of the recent studies of malaria and allied diseases which have led to the investigation in such extraordinary detail of protozoan animals and of the insects which act as their temporary hosts. As such it makes no pretense to literary merit, but is an excellent and extremely practical guide to the methods of investigation of these diseases which must be very valuable to those who go out to the tropics for their study. Elaborate apparatus is not recommended, the most simple expedients which frequently answer so well being described in each case—when it is a question of a bottle, it is the whiskey bottle—and in every case ordinary household utensils are made to do duty in order to avoid the transportation of much baggage.

The authors describe the technique of the examination of blood, then the blood itself, after which they turn to the life history of the malarial parasite and its effects on the blood and tissues. Sixteen chapters then follow upon the mosquitoes, their general life history, their eggs, larvæ, etc., modes of experimenting with them and of dissecting and studying their anatomy. The classification of the various genera and species, many of which are of such recent recognition, is followed by a minute description of the general nature, habits and anatomy of the forms of Anopheles which are so important in relation to malaria. Geographical and clinical studies of malaria, as well as of the Blackwater fever, receive some attention, and the last chapters are devoted to various other protozoan parasites, especially the trypanosomata and the filariæ.

There is some repetition, especially in the various descriptions of the life history of the malarial parasite and of the mosquitoes, and there is some obscurity as to the relations of each of these mosquitoes to the various types of the disease—an obscurity which must remain until cleared up by further work. On the whole, however, for the purpose intended the book seems an admirable one.

A Text-book of Operative Surgery. Covering the Surgical Anatomy and Operative Technic involved in the Operations of General Surgery. Written for students and practitioners. By Warren Stone Bickham, Phar. M., M. D., Assistant Instructor in Operative Surgery, College of Physicians and Surgeons, New York; Late Visiting Surgeon to Charity Hospital, New Orleans, etc. Second revised edition. Octavo of 984 pages, with 559 illustrations. (*Philadelphia, New York, London: W. B. Saunders & Company, 1904.*)

The exhaustion of the first edition of this work and the demand for another edition are good indications of the popularity of the book. A notice of the first edition appeared in the Bulletin for January of the present year. The second edition has not been essentially changed and the labor of the author has been restricted for the most part to the correction of typographical errors. The book is a very creditable specimen of book-making. It has an excellent index.

Obstetrics for Nurses. By Joseph B. De Lee, M. D., Professor of Obstetrics in the Northwestern University Medical School, Chicago; Lecturer in the Nurses' Training Schools of Mercy, Wesley, Provident, Cook County, and Chicago Lying-in Hospitals. 12mo. of 460 pages, fully illustrated. (*Philadelphia, New York, London: W. B. Saunders & Company, 1904.*)

This book is designed to serve as a text-book of obstetrics for nurses, and as a guide in the care of obstetrical patients. It is well adapted for use as either. It is clearly and concisely written, well printed and unusually well illustrated. The obstetrical teaching is sound and the instructions for the care of the patient during pregnancy, labor and the puerperium are excellent.

Golden Rules of Anæsthesia. By R. J. Probyn-Williams, M. D., Senior Anæsthetist and Instructor in at the London Hospital. Golden Rule Series, No. XIV. (*Bristol: John Wright & Co., London: Simpkin, Marshall, Hamilton, Kent Co., Lim.*)

This volume should be placed in the hands of every person who has occasion to administer an anæsthetic. The advice which it gives is concise and the principles taught are most valuable. It deserves careful study and consideration.

The Mattison Method in Morphinism. A Modern and Humane Treatment of the Morphin Disease. By J. B. Mattison, M. D. (*Published for the Author. E. B. Treat & Company, New York.*)

This primer of 40 pages is a plea for the employment of the bromides in the treatment of morphia addiction. The author prefers to use the bromide of sodium, given twice in 24 hours, to secure the continuous presence of this drug in the patient's blood. He begins with initial doses of 10 grains of bromide of sodium and increases the amount given up to 100 grains twice in 24 hours. While he is thus increasing the dosage of the bromide of sodium he is constantly diminishing that of the usual opiate until the latter is wholly withdrawn on the tenth day. After the opiate has been discontinued he resorts to codein to treat the nervous symptoms, in doses of 1 to 2 grains every 3 to 5 hours. Like many other physicians connected with private sanitaria for habit cases, the author seems inclined to exaggerate the distress of persons who are suddenly deprived of morphia. A long experience with such cases leads the writer to think that the majority may be deprived of the drug at once and without any harm, provided they are carefully nursed and properly fed. Some exceptional cases may require to have the drug withdrawn gradually

[34] 11 Md. Arch., 4, 67.

or another drug substituted for it. The patient who has usual physical vigor makes more rapid recovery and develops more strength of purpose and moral vigor if he is deprived of the pernicious drug at once.

A System of Practical Surgery. By PROF. E. VON BERGMANN, PROF. P. VON BRUNS and PROF. J. VON MIKULICZ. Vol. II. Translated and edited by WILLIAM T. BULL, M. D., Professor of Surgery, Columbia University, and CARLTON P. FLINT, M. D., Instructor in Minor Surgery, Columbia University, New York. Surgery of the Neck, Thorax and Spinal Column.. (*New York and Philadelphia: Lea Brothers & Company, 1904.*)

Those who may have expected, from an American edition of Bergmann, Bruns and Mikulicz's well known "Handbuch der praktischen Chirurgie," what has been realized in the English translation of Nothnagel's System, for example, will be bitterly disappointed. The present surgical volume deals with the surgery of the neck, thorax and spinal column, and to the original chapters, not only has nothing of value been added, but they have lost much of their original character. The volume is published on heavy paper which, together with the insertion of some two dozen plates, brings its physical size and weight up to that of the German original. Two important chapters are missing—that by v. Hacker on the Œsophagus (104 pages) and another on the Pelvis by Steinthal (69 pages)—which may possibly appear in a later volume. The fact that they are not included in the present volume should have been explained.

One who is accustomed to using the German original misses greatly the German method of italicizing important words and sentences, also of putting the less essential, though pertinent, matters in smaller type. Regrettable above all is the omission of the bibliographical references which the authors of the various chapters in the original had carefully appended to their articles. Why this should have been done it is difficult to understand, as the references required no translation and would have taken, all told, but a few pages of the book, which now contains, including fragments at the ends of chapters, *twenty pages* of blank paper, for example, 92, 142, 366, 292, and 561, 562 and 563.

The illustrations also are deserving of serious criticism. There have been added to the book expensive and unnecessary colored plates, some twenty in number, which do not serve even to make the book superficially attractive. The anatomical plates borrowed from Spalteholtz, Testut, Joessel, etc., are absolutely inappropriate to a surgical work of this kind, and furthermore have lost their simple anatomical value as the structures in these reproductions are no longer carefully labeled as they were in the original. From Kocher's "Operationslehre" are also borrowed several plates; the one bad feature of that otherwise superior volume—its illustrations—having been taken to "grangerize" a volume in no sense an operative surgery. The legends under Figs. 140 and 141 are transposed.

Something of the individuality of the separate sections has been lost, for those unacquainted with the original, by the neglect in many instances of placing under the titles the names of the distinguished surgeons who are responsible for them.

The translation is only fairly well done. The arrangement of chapters and sections has not been strictly adhered to, and as a result a lack of proportion is noticeable in the various chapters. As examples, see Chapters XX and XXI, which are merely sections in the original.

The publishers have done their part excellently well. Printing, illustrations and paper are all most creditable. When publishers have made such a creditable effort to issue a standard book, it is to be regretted that the work of translation and editing has not received the same attention.

Intercolonial Medical Congress of Australasia. Transactions of the Sixth Session, held in Hobart, Tasmania, February, 1902. Published under the Direction of the Literary Committee By GREGORY SPROTT, M. D. (*Tasmania: John Nail, Government Printer, Hobart, 1903.*)

This volume of nearly 500 pages gives an interesting report of the work of the Australasian Intercolonial Medical Congress. Many of the papers are timely and full of interest, as, for example, "Notes on the Epidemic of Plague in Sydney," "Tropical Dysentery," the "Sanatorium Treatment of Consumption," and the series of papers on Cancer. They are well worth careful reading.

A Manual of Syphilis and the Venereal Diseases. By JAMES NEVINS HYDE, A. M., M. D., Rush Medical College, and FRANK HUGH MONTGOMERY, M. D., Rush Medical College, Chicago. Second edition, revised and enlarged. With 58 illustrations in the text and 19 full-page lithographic plates. (*Philadelphia: W. B. Saunders & Company, 1904.*)

This whole book is worthy of careful study on the part of the student and physician. Certain chapters, however, ought to be in the hands of every physician. The chapter entitled, "Syphilis, in relation with the family and society," contains so much sound sense and such careful instructions as to the duty of the physician to protect an innocent member of the household from an infected partner that it is worthy of special mention. The chapter on "Hypochondriasis" also treats judiciously of a condition which is frequently brought to the attention of all practitioners of medicine. The instruction which it contains is well calculated to benefit all who have to deal with the various forms of sexual hypochondria.

In the chapter on acute urethritis it is worthy of notice that the authors do not share the enthusiasm felt by many for the so-called "Janet method" of treating gonorrhœa. This seems to have been the experience of the vast majority of physicians who have attempted to treat this disorder by local treatment only.

The book is well written, excellently illustrated and attractively printed, and deserves a wide use.

International Clinics. A Quarterly of Illustrated Clinical Lectures and especially prepared Original Articles. Edited by A. O. J. KELLY, M. D. Vol. II, 14 Series. (*Philadelphia: J. B. Lippincott Company, 1904.*)

A considerable portion of this volume is taken up with the diseases of warm climates and there are a number of excellent articles. Dr. Mason, of the Army, writes on the spread of disease by insects, with special reference to prophylaxis. The article is illustrated by a number of plates to assist in the recognition of the various forms of mosquitos, and a number of excellent practical points are given. Dr. John McCrae, of Montreal, contributes an article on recent progress in tropical medicine and sums up much of the recent work. As might be expected, trypanosomiasis occupies a large space. Dr. Krauss, of Memphis, contributes an excellent article on malarial hæmoglobinuria. In reference to the treatment, Dr. Krauss lays emphasis on the fact that the prophylaxis of malaria will prevent blackwater fever, but when the attack has been precipitated quinine has no place in the therapy. There is a good article by Dr. Allen Smith on uncinariasis, and we are glad to see that in the treatment he advises giving larger doses of thymol than is usually done. He does not hesitate to give 90 grains in three doses. There are two articles on abscess of the liver. The first is by Dr. James Cantlie, of London. He notes some of the doubtful points in regard to the subject, and makes the statement that amœbæ coli are not present in the pus from a deep-seated suprahepatic abscess until the third day after operation. There is little doubt that if scrapings were taken from

the wall of the abscess cavity at the time of the operation, amœbæ would usually be found. They are very rarely found in the pus at operation, although this rule is not without exceptions. The various operative procedures are described at length and especially the operation by the trochar and cannula, of which the operator speaks with favor. Dr. Thompson discusses the symptoms and the diagnosis rather more fully.

The second section deals especially with the treatment of various conditions of the vascular system. Dr. Bierring emphasizes the importance of the recognition of arterio-sclerosis of the gastro-intestinal vessels. There is one article on the use of digitalis in cardiac disease and one on chronic valvular disease which do not add especially to the sum of human knowledge. The remaining articles are of a miscellaneous character and do not require any special mention.

A Handbook of Ophthalmic Science and Practice. By HENRY E. JULER, F. R. C. S., Ophthalmic Surgeon to St. Mary's Hospital; Consulting Surgeon to the Royal Westminster Ophthalmic Hospital; Consulting Ophthalmic Surgeon to the London Lock Hospitals. With illustrations. Third edition. Revised and enlarged. (*Philadelphia: Lea Brothers & Company, 1904.*)

This work has long held a high place in ophthalmic literature, and the last edition shows no falling away from the standard which was set by the first edition nearly twenty years ago. Like most English writers on medical subjects, the author gives us his own views and there is no wandering into foreign lands in search of precedent, or comparison of sanction for this or that opinion or method of treatment. He works out his own salvation in the great eye clinics of London. As a consequence we miss reference to some of the valuable contributions which have been made to ophthalmology by other than Englishmen. We note with satisfaction that interstitial keratitis is not uncommonly to be attributed to tuberculosis, a view which we have long upheld and one which finds strong supporters in von Hippel and others. We cannot, however, agree with him in his explanation of the cause of pannus, the origin of which he regards as entirely mechanical; in other words, as due to the irritation produced by either the rough granular lid or the incurved tarsus rubbing upon the cornea. It seems far more likely that pannus is due to a direct invasion of the cornea by the trachomatous process, and that we have pretty much the same process in the cornea as in the conjunctiva of the upper lid. The location of the pannus on the upper half of the cornea is due to the fact that that part of the cornea is in constant contact with probably the most highly infected part of the conjunctival surface, namely, with the conjunctiva of the upper lid, for in this location we usually have the most intense manifestations of the disease. In speaking of the treatment of trachoma nitrate of silver in the acute stage is given the first place, and properly so, we think, but it seems surprising that no mention is made of the other silver salts, particularly of protargol, which in 30 and 40 per cent solutions has been found by many more satisfactory than copper sulphate in the treatment of the later stages of the disease.

The work is generously illustrated with wood-cuts, half-tone plates and photomicrographs. There may be a suggestion of an insular origin in its therapeutics, but as it is the product of an experienced and distinguished ophthalmologist we can commend it cordially and wish it long life and prosperity.

Röntgen Ray Diagnosis and Therapy. By CARL BECK, M. D., Professor of Surgery in the New York Post-Graduate Medical School and Hospital. With 322 illustrations in the text. *New York and London: D. Appleton & Company, 1904.*)

The literature upon the application of the X-rays has become very extensive. In the past few years many contributions have been made.

In the preface of the present volume the author apparently thinks, however, that from the clinical standpoint the X-ray has been neglected and so says the object of his book is "to demonstrate how Röntgen rays can best be utilized in medical and surgical practice."

The book may be roughly divided into three sections. Section one, which is devoted to apparatus and X-ray technique, is much to be commended, as in it the author gives a very good and concise description of the various parts of an X-ray equipment. The reader is not burdened with useless details, but simply has before him the chief and salient points. The part of this section devoted to the X-ray tube is especially good.

The second section deals with the diagnostic value of the X-ray. In passing we may say that here the author attempts to introduce the words "Rontgograph" and "Rontgography," to replace radiograph and radiography. These latter terms, he says, are the words "constructed by violent word composers," and consequently should not be used. The old terms, however, are so well fixed that we need not fear the introduction of these new and cumbersome words.

This section is illustrated with a number of good radiographs. Those on fractures before and after treatment are especially good.

In this connection it seems to the reader that the author goes beyond the province of his subject in presenting the details of surgical treatment. The proper way to apply splints and plaster bandages to a fracture is surely foreign to a book on "Röntgen Diagnosis and Therapy."

In another place considerable space is devoted to the surgical procedures required in excising the head of the humerus for an old dislocation which had been recognized by means of a radiograph.

In this way much that is good is spoiled by compelling the reader to consider methods of treatment and purely surgical procedures. The majority of persons who wish such details of surgery prefer to consult a text-book on surgery and not one on "Röntgen Diagnosis and Therapy."

Section three is devoted to Therapy. In this part the various diseases amenable to the X-ray are discussed. The illustrations in this section are very good and well worth looking over.

The last two chapters are devoted to brief summaries of the methods of use and what has been accomplished with the Finsen ray and radium.

The Right to Life of the Unborn Child. A Controversy between Professor Hector Treus, M. D., Rev. R. van Oppenraay, D. D., S. J., and Th. M. Vlaming, M. D. (*New York: Joseph F. Wagner.*)

The purpose of this polemic is to justify the position of the Roman Catholic Church in regarding the life of the fœtus as of greater moment than the life of the mother. The view-point of the priest in this matter is so different from the physician's that a medical review of the discussion is scarcely possible.

The Practical Care of the Baby. By THEBON WENDELL KILMER, M. D., Associate Professor of Diseases of Children in the New York School of Clinical Medicine. (*Philadelphia: F. A. Davis Company, 1903.*)

The book contains 150 pages, well printed on good paper. The illustrations are numerous, but chiefly consist of photographs of a doll arranged in various garments and held in different attitudes. The subject matter is the conventional care of the baby as already given by several books on the market, and it is difficult to see where there was a need for this volume.

A Treatise on Orthopedic Surgery. By ROYAL WHITMAN, M. D., Instructor in Orthopedic Surgery in the College of Physicians and Surgeons of Columbia University, New York. Second edition, revised and enlarged. Illustrated with 507 engravings. (*Philadelphia and New York: Lea Brothers & Company, 1903.*)

The first edition of Whitman's Orthopedic Surgery was so well received and has become so well known that little need be said about the second edition. The book has been revised, much new material and many illustrations added, and some of the chapters rewritten.

As might be supposed from the interest taken in the subject in this country last year, the chapter on Congenital Dislocation of the Hip has been enlarged and a more detailed description given of the Lorenz bloodless operation for the reduction of the hip. The author recommends that this operation be employed in all cases under 6 or 8 years of age, and that the open operation be performed when a cure has not been obtained.

The tuberculin test in the diagnosis of joint affections is mentioned only to be condemned on account of the frequency of tubercular glands, especially in children, causing a reaction when there is no disease in the joint. Evidently the local reaction has been overloked, or Dr. Whitman does not attribute the same importance to it as do some others.

The subject of orthopedics has been admirably treated by the author and the ground has been thoroughly covered, the latest methods being embodied in this book. References have also been given to the more important literature.

The general arrangement of the book is excellent. The subject headings are in heavy black type and paragraphs on differential diagnosis, and recapitulations, so important to the student, are frequent.

Nearly all of the appliances for treatment of orthopedic conditions are carefully described and well illustrated, the author giving the advantages and disadvantages of the different methods of treatment of the same condition at different stages of the disease, and, what is always important, telling what method he employs, and why he prefers it to others.

The book can be most highly recommended to those interested in orthopedics.

The Practical Medicine Series of Year Books. Comprising 10 Volumes on the Year's Progress in Medicine and Surgery. Under the General Editorial Charge of GUSTAVUS P. HEAD, M. D., Professor of Laryngology and Rhinology, Chicago Post-Graduate Medical School. Vol. III. The Eye, Ear, Nose and Throat. Edited by DRS. CASEY A. WOOD, ALBERT H. ANDREWS and GUSTAVUS P. HEAD. (*Chicago: The Year Book Publishers, December, 1903.*)

This is the third series of these year books, and the high standard presented in former years has been maintained. The abstracts of important papers are fairly complete and satisfactory. The one criticism we would make of this volume is that we believe the section devoted to diseases of the ear is incomplete. There are only six references in this department to articles appearing in foreign journals, and even some of the American publications have been entirely ignored. Most of the journals which we have in mind should have been at the command of the reviewer and it is hardly reasonable to suppose that none of them contained articles worthy of consideration.

H. O. R.

Diseases of the Eye. By L. WEBSTER FOX, A. M., M. D., Professor of Ophthalmology in the Medico-Chirurgical College of Philadelphia, Pa.; Ophthalmic Surgeon in the Medico-Chirurgical Hospital. With 5 colored plates and 296 illustrations in the text. (*New York and London: D. Appleton & Company, 1904.*)

Perhaps every book that is published contains some measure of good and the reviewer is generally pleased if this be sufficient to afford an opportunity to praise the author and his work, but there are many instances where this element of praiseworthy work is so small, as compared with the poor quality of the balance, that the whole effort falls under the ban of criticism. It would seem to us that this is one of the occasions when the book under consideration deserves condemnation rather than praise. It contains nothing that is particularly new and nothing that is not expressed far better in any one of three or four existing American text-books on Ophthalmology. The few new features that are introduced as the work of the author present little of originality, for they are practically all adaptations of or modifications of the work of others. We are even disappointed in the illustrations. The five colored plates are very good, two of them representing the high class work for which Miss Washington has become noted, but fully one-half of the text illustrations are simply duplicates of those used in the American edition of Fuchs and another large percentage are reprinted from Norris and Oliver's System.

From the preface we learn that treatise was prepared especially for the use of students of medicine, and are told that "the author has aimed at simplicity of diction in an effort to present to them, in language they can comprehend, the principles which underlie the normal as well as the pathological changes that take place in the eye and its appendages;" and yet, in the course of the work, so many high sounding and rarely used words are employed that it is necessary to append an eight-page glossary.

From the same source we ascertain that the book expresses "the author's own views of pathology and methods of treatment." In regard to the question of pathology, we feel quite sure that no one will dispute the claim; it is weak throughout and woefully out of date in some particulars.

The publisher's part of the work has been very satisfactorily performed, and we sincerely regret that we cannot say as much of the labors of the author.

H. O. R.

Normal Histology. A Manual for Students and Practitioners. By JOHN R. WATHEN, A. M., M. D., Professor of Surgery and Gynecology, formerly Professor of Histology and Pathology, Kentucky School of Medicine, Louisville, Ky. 12mo, 220 pages, 114 illustrations. (*Philadelphia and New York: Lea Brothers & Company, 1903.*)

This book is designed to replace the popular Quiz Compend, and its arrangement is certainly much superior to that of the Compend. It commences with a chapter on the cell, takes up the various tissues and organs successively, includes a short chapter on embryology and ends with one on histological technique. Each chapter in a brief, clear description gives a short summary of the organ or tissue described, and has appended to it a set of questions to facilitate review.

The arrangement is a good one, but necessarily in so brief a work completeness and accuracy are subservient to brevity and disputed points are sometimes treated rather dogmatically. For example, "endothelium, including the linings of the lymphatics, blood vessels and serous cavities, are classified with epithelium on account of its morphological resemblance to squamous epithelium, but more properly belongs with the connective tissues as it owes its origin to the same layer of the blastoderm"—a point as yet unsettled. And the spleen is considered of greater importance than the bone marrow in the formation of the leucocytes of the blood. However, such examples are not frequent and much information is crowded into a small space.

The illustrations are chosen with good judgment from other works, but are rather poorly reproduced.

The book should be useful to those who are taking a short course in histology or who wish to review the subject rapidly and have not the time to study one of the larger and more complete works on histology.

BOOKS RECEIVED.

A Manual of Clinical Diagnosis. By Means of Microscopical and Chemical Methods. For Students, Hospital Physicians and Practitioners. By Charles E. Simon, M. D. Fifth edition, thoroughly revised and enlarged. Illustrated with 150 engravings and 22 plates in colors. 1904. 8vo. 695 pages. Lea Brothers & Co., Philadelphia and New York.

The Medical Annual. A Year Book of Treatment and Practitioner's Index. 1904. Twenty-second year. 12mo. 999 pages. John Wright & Co., Bristol; Simpkin, Marshall, Hamilton, Kent & Co., London.

Golden Rules of Dental Surgery. By Charles W. Glassington, M. R. C. S., L. D. S. ED. "Golden Rules" Series No. XIII. 32mo. 69 pages. John Wright & Co., Bristol; Simpkin, Marshall, Hamilton, Kent & Co., London.

Saint Bartholomew's Hospital Reports. Edited by A. E. Garrod, M. D., and W. McAdam Eccles, M. S., F. R. C. S. Volume XXXIX. 1903. 8vo. 211 pages. 1904. Smith, Elder & Co., London.

Obstetrics for Nurses. By Joseph B. De Lee, M. D. Fully illustrated. 1904. 12mo. 460 pages. W. B. Saunders & Company, Philadelphia, New York, London.

Manual of Clinical Microscopy and Chemistry. Prepared for the Use of Students and Practitioners of Medicine. By Dr. Hermann Lenhartz. Authorized translation from the fourth and last German edition, with notes and additions, by Henry T. Brooks, M. D. With 148 illustrations in the text and 9 colored plates. 1904. 8vo. Pages XXVIII + 412. F. A. Davis Company, Philadelphia.

Scientific Memoirs. By the Officers of the Medical and Sanitary Departments of the Government of India. (New Series.) No. 6. *First Report of the Anti-Malarial Operations at Mian Mir, 1901-1903.* By Captain S. P. James, M.B. (Lond.), I.M.S. Issued under the Authority of the Government of India, by the Sanitary Commissioner with the Government of India, Simla. 1903. 4to. 53 pages. Office of the Superintendent of Government Printing, Calcutta.

A Text-Book of Physiology. By Isaac Ott, A. M., M. D. With 137 Illustrations. 1904. 8vo. 563 pages. F. A. Davis Company, Philadelphia.

Treatise on Diseases of the Skin. For the Use of Advanced Students and Practitioners. By Henry W. Stelwagon, M. D., Ph. D. Third edition. With 220 illustrations in the text, and 26 full-page lithographic and half-tone plates. 1904. 8vo. 1115 pages. W. B. Saunders & Company, Philadelphia, New York, London.

Atlas and Epitome of Operative Gynecology. By Dr. Oskar Schaeffer. Authorized translation from the German with editorial notes and additions. Edited by J. Clarence Webster, M. D. (Edin.), F. R. C. P. E., F. R. S. E. With 42 colored lithographic plates and many text-illustrations, some in colors 1904. 12mo. 138 pages. W. B. Saunders & Company, Philadelphia, New York, London.

Burdett's Hospital and Charities. 1904. Being the Year Book of Philanthropy and the Hospital Annual. By Sir Henry Burdett, K. C. B. 12mo. 1122 pages. The Scientific Press (Limited), London.

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